

# Innovative Programmes - Engineering New Degrees

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# Historical Context

- Structure of undergraduate degrees in UCL Civil Engineering had undergone only incremental change over 30 years
- Applicants' qualifications were just “off the pace”, with UCL often seen as an insurance if applicants failed to get a place at Imperial College or Oxbridge
- School heads told us that many good students prefer degrees with a broad curriculum and avoid the straight jacket suggested by a vocational degree
- Industry emphasized the need for free-thinking and adaptable graduates with well-developed problem-solving skills

# Context

- Young Civil Engineering researchers offered a student view that traditional engineering degrees are not exciting and do not provide appropriate education
- Students seen to lose motivation
- Too much teaching, with little time to think and apply knowledge
- Staff frustrated by perceived imbalance of workload
- Staff frustrated by conflict in timetable between project work and lecture-based teaching

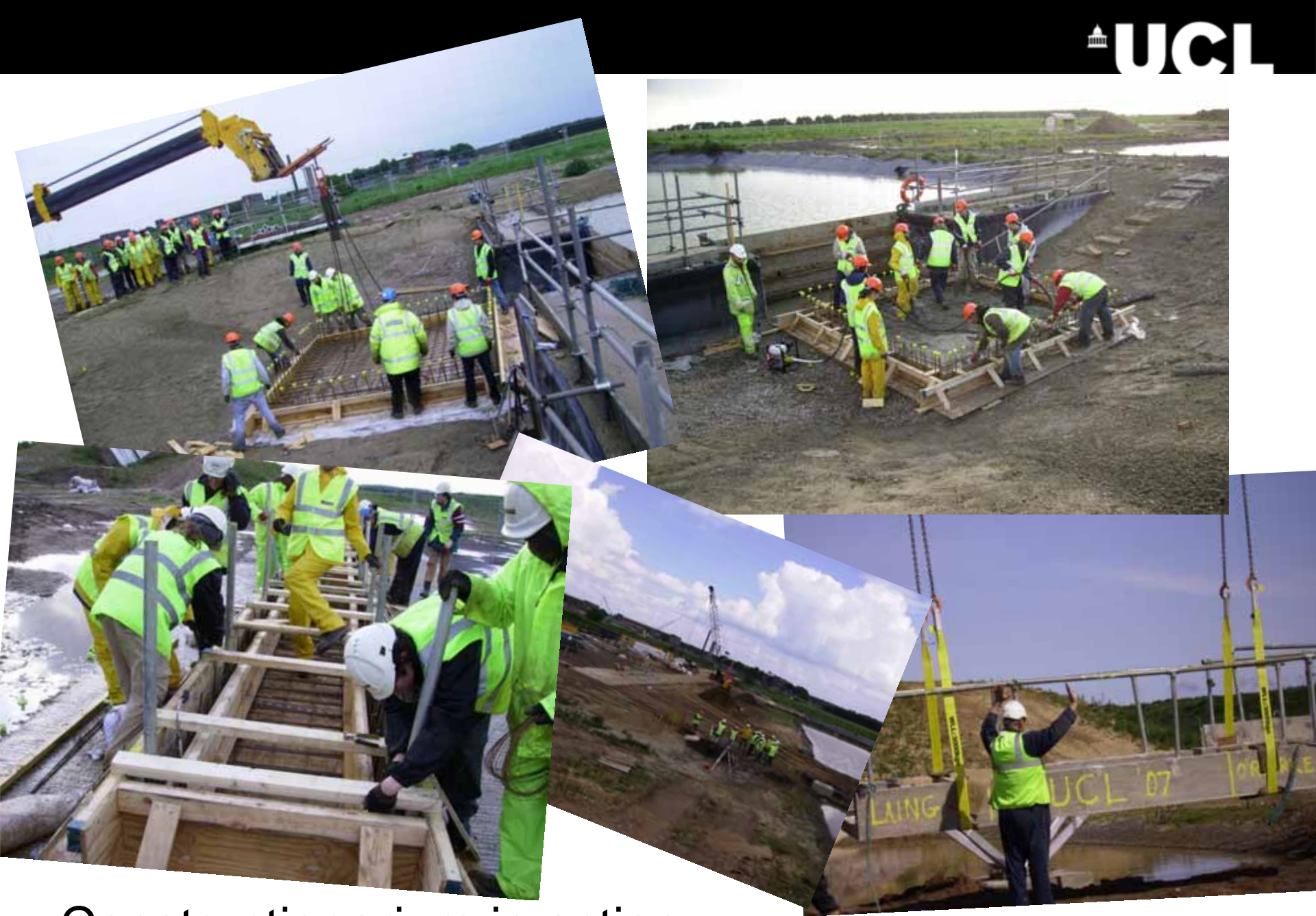
*Here we explain what has been done to address some of these issues ....*

# Aims of the new degree programmes

- To attract the brightest students into an engineering education
- To produce graduates capable of clear thinking, good communication skills and managing large-scale engineering projects, comfortable with complex inter-disciplinary issues, not afraid to innovate, and equipped to take on challenges beyond the vocational boundaries traditionally associated with engineering degrees
- To offer degree programmes radically different in structure and content from those of our competitors

# The changes ....

- Simplified the choice of undergraduate degrees offered
- Admissions criteria raised
- Interview procedures modernised and streamlined
  
- Academic year re-shaped around major projects
- New roles found for research-focused academic staff
  
- Syllabus balanced between analytical methods and the context in which they can be applied
- Emphasis on the “big picture” earlier in degree programmes
  
- Teaching programme restructured into four cross-cutting “clusters”
- Assessment through a single 4-unit course
  
- Constructionarium introduced to the curriculum



Constructionarium in action

## Old degrees ..... 12 of them

- B.Eng. Civil Engineering
- B.Eng. Civil Engineering (**4 year STEPS programme**)
- B.Eng. Civil **and** Environmental Engineering
- B.Eng. Structural Engineering
- B.Eng. Geoinformatics
- B.Eng. Geospatial and Environmental Information Management
- M.Eng. Civil Engineering
- M.Eng. Civil Engineering (with a year abroad)
- M.Eng. Civil **with** Environmental Engineering
- M.Eng. Structural Engineering
- M.Eng. Geoinformatics
- M.Eng. Geospatial and Environmental Information Management

## New degrees .....

- B.Eng. Civil Engineering
- B.Eng. Environmental Engineering
- B.Eng. Geoinformatics
- M.Eng. Civil Engineering
- M.Eng. Civil Engineering (International Programme)
- M.Eng. Environmental Engineering
- M.Eng. Environmental Engineering (International Programme)
- M.Eng. Geoinformatics

# Teaching in 1<sup>st</sup> and 2<sup>nd</sup> years

- Common 1<sup>st</sup> year teaching across all programmes
  - broadening student curriculum
  - efficiency of teaching effort
- Common 2<sup>nd</sup> year teaching in Autumn Term
- Presentations by industry in November to inform students of the career choices available to them, with a final choice of degree to be made by end of the Autumn Term in 2<sup>nd</sup> year
- Specialist teaching in 2<sup>nd</sup> year Spring Term
- Specialist diets for 3<sup>rd</sup> and 4<sup>th</sup> years, with courses generally offered to more than one programme (including MSc programmes)

# An Uncommon Timetable

## – Quarters & Scenarios

- Teaching year (Autumn and Spring terms) is divided into four “Quarters” each lasting 5 weeks
- Quarters have four weeks of teaching and a major one-week group project known as a “Scenario”
- Teaching in the four weeks is based around lectures, seminars, laboratory classes, and visits
- There is no formal teaching during Scenario weeks, but staff are available for consultation to guide student groups towards their goals

## From silos to frameworks ....

- Syllabus for 1<sup>st</sup> and 2<sup>nd</sup> years of old degrees  
*(taught in eight half-unit courses):*  
**Structures, Soils, Fluids, Materials, Design, Mathematics, Geology, Measurement, Society**
- Syllabus for 1<sup>st</sup> and 2<sup>nd</sup> years of new degrees re-mapped to clusters  
*(administered as a single 4-unit course):*  
**Context, Change, Mechanisms, Tools**
- Achieved by asking all staff to list core “**Learning Outcomes**” for their subject and to mark each as Context, Change, Mechanisms or Tools
- Learning Outcomes timetabled to mesh with the requirements of the multi-disciplinary Scenarios

Week no.		0	1	2	3	4	5	6	7	8	9	10	11			
Week start		<b>24-Sep</b>	<b>01-Oct</b>	<b>08-Oct</b>	<b>15-Oct</b>	<b>22-Oct</b>	<b>29-Oct</b>	<b>05-Nov</b>	<b>12-Nov</b>	<b>19-Nov</b>	<b>26-Nov</b>	<b>03-Dec</b>	<b>10-Dec</b>			
Week end		<b>28-Sep</b>	<b>05-Oct</b>	<b>12-Oct</b>	<b>19-Oct</b>	<b>26-Oct</b>	<b>02-Nov</b>	<b>09-Nov</b>	<b>16-Nov</b>	<b>23-Nov</b>	<b>30-Nov</b>	<b>07-Dec</b>	<b>14-Dec</b>			
		Induction Week	QUARTER 1					Reading Week	QUARTER 2							
Monday	09:00-10:00	See separate induction week schedule	Maths (AV Hill)	Maths (AV Hill)	Maths (AV Hill)	Maths (AV Hill)	Scenario 1 (G.08)		Maths (AV Hill)	Maths (AV Hill)	Maths (AV Hill)	Maths (AV Hill)	Scenario 2 (G.08)			
	10:00-11:00		Structures (DLT)	Structures (DLT)	Structures (DLT)	Structures (DLT)			Structures (DLT)	Structures (DLT)	Structures (DLT)	Structures (DLT)		Structures (DLT)		
	11:00-12:00		Fluids (DLT)	Fluids (DLT)	Fluids (DLT)	Fluids (DLT)			Fluids (DLT)	Fluids (DLT)	Fluids (DLT)	Fluids (DLT)		Fluids (DLT)		
	12:00-13:00		P/Tutorial 1	P/Tutorial 1	P/Tutorial 1	P/Tutorial 1			P/Tutorial 1	P/Tutorial 1	P/Tutorial 1	P/Tutorial 1		P/Tutorial 1		
	13:00-14:00															
	14:00-15:00		Context (26 Bedford Way--LG04)	Context (26 Bedford Way--LG04)	Context (26 Bedford Way--LG04)	Context (26 Bedford Way--LG04)			Context (26 Bedford Way--LG04)	Context (26 Bedford Way--LG04)	Context (26 Bedford Way--LG04)	Scenario 1 Feedback (G.08)		Scenario 2 Introductory Lecture (G.08)	See Lab Timetable	See Lab Timetable
	15:00-16:00															
16:00-17:00																
Tuesday	09:00-10:00	See separate induction week schedule	Materials (G.08)	Materials (G.08)	Materials (G.08)	Materials (Roberts G.08 Davies LT)	Scenario 1 (G.08)		See Lab Timetable	See Lab Timetable	See Lab Timetable	See Lab Timetable	Scenario (G.08)			
	10:00-11:00															
	11:00-12:00													Materials (G.08)		
	12:00-13:00															
	13:00-14:00															
	14:00-15:00		Materials (G.08)	Materials (G.08)	Materials (G.08)							Materials (G.08)				
	15:00-16:00															
16:00-17:00																
Wednesday	09:00-10:00	See separate induction week schedule					Scenario (G.08)						Scenario (G.08)			
	10:00-11:00		Sc 1 Intro (G.08)		Systems (G.08)				Design (G.08)	Design (G.08)	Design (G.08)					
	11:00-12:00		Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)			Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)		Maths (JZ Young)		
	12:00-13:00		Fluids (B.05)	Soils (B.05)	Fluids (B.05)	Soils (B.05)			Fluids (B.05)	Soils (B.05)	Fluids (B.05)	Soils (B.05)				
	13:00-14:00															
	14:00-15:00															
	15:00-16:00															
16:00-17:00																
Thursday	09:00-10:00	See separate induction week schedule	Env Eng (WH)	Env Eng (WH)	Env Eng (WH)	Env Eng (WH)	Scenario 1 (G.08)		Env Eng (WH)	Env Eng (WH)	Env Eng (WH)	Env Eng (WH)	Scenario (G.08)			
	10:00-11:00				Structures (WH)									Structures (WH)	Structures (WH)	
	11:00-12:00		Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)			Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)	Maths (JZ Young)		Maths (JZ Young)		
	12:00-13:00															
	13:00-14:00															
	14:00-15:00		Context (G.08)	Context (G.08)	Context (G.08)	Context (Ramsay LT, Chemistry Bldg)			Context (G.08)	Context (G.08)	Context (G.08)	Context (Ramsay LT, Chemistry Bldg)				
	15:00-16:00															
16:00-17:00																
Friday	09:00-10:00	See separate induction week schedule				Design testing (G.04)	Scenario 1 (G.08)						Scenario (G.08)			
	10:00-11:00		Maths (B.05)	Maths (B.05)	Maths (B.05)				Maths (B.05)	Maths (B.05)	Maths (B.05)	Maths (B.05)				
	11:00-12:00		Soils (B.05)	Soils (B.05)	Soils (B.05)				Soils (B.05)	Soils (B.05)	Soils (B.05)	Soils (B.05)				
	12:00-13:00		P/Tutorial 2	P/Tutorial 2	P/Tutorial 2	P/Tutorial 2			P/Tutorial 2	P/Tutorial 2	P/Tutorial 2	P/Tutorial 2				
	13:00-14:00															
	14:00-15:00		Design (G.08)	Systems (G.08)	Geomatics (G.08)	Design (G.08)			Maths (B.05)	Materials (G.08)	Geomatics (G.08)	Scenario 2 Workshop (G.08)		Design (B.05)		
	15:00-16:00								Soils (B.05)							
16:00-17:00		Design (G.08)	Design (G.08)		Design (B.05)		Design (G.08)									



# Clusters

## Context:

Offers an appreciation of the technical, political, and cultural contexts of engineering and interactions with the environment. Focus on clients, planning, regulation, legislation, economics and history.

## Change:

Builds on the understanding and skills gained in other parts of the syllabus to plan and realise an outcome. Focus on design skills, systems, management of projects and creativity development.

# Clusters

## Mechanisms:

Develops an understanding of the theories underpinning engineering processes, where and why they are similar in different fields and where and why they are different.

## Tools:

Helps to develop a variety of skills, in mathematics, communications, land surveying, computing and drawing

# Scenarios - the essential ingredient of our new degree programmes

- One-week multi-disciplinary projects to apply taught material and identify need for future study
- Students work in groups – different size, membership and roles for each project
- Assessment against different criteria for each project



- Each scenario run by two academics:
  - one to link curriculum to the project,
  - the other to organise the project logistics

# Scenarios - the essential ingredient of our new degree programmes

## Year 1:


- Traffic and pollution in St Albans – concepts
- Bridge design
- Shrimp farm in the Thames Estuary
- St Albans ii - detail



## Year 2:

- Community Centre
- Offshore wind farm
- Airport expansion
- Drought in SE England

## Scenarios - the essential ingredient of our new degree programmes

- Major task for staff to prepare a Scenario and make contact with relevant industrial advisors
  - Major staff commitment during Scenario week
  - Major task to arrange marking of group and individual work and subsequent feedback
- 
- A photograph showing a group of people in a meeting room. One person is standing and pointing at a whiteboard, while others are seated around a table with laptops and water bottles. The room has white walls and a whiteboard.
- Offers an opportunity for staff whose research interests are not part of the traditional 1<sup>st</sup> or 2<sup>nd</sup> year curriculum to play an active role in teaching



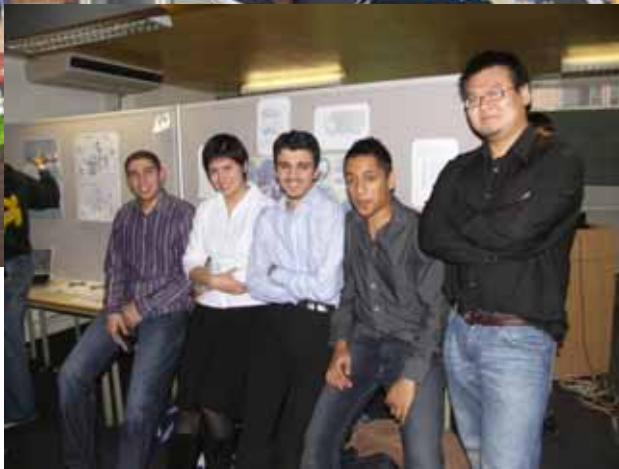
Site survey in St Albans



Students briefing by staff in St Albans



The group-thinking stage ....



Waiting for questions ...



Review by Chief Engineer, Atkins

# Reduction in report-writing

- As in the old degree programmes, students are required to carry out laboratory experiments to underpin lecture-based teaching
- Understanding of the mechanisms being demonstrated in the experiments is assessed by short reports, by examination and in scenarios
- Full reports are required for only a few of the experiments, specifically to develop and test technical writing skills

## Assessment structure – 1<sup>st</sup> and 2<sup>nd</sup> years

- Assessment for each year is managed within a single 4-unit course
- This gives flexibility to introduce small components into the curriculum without a need to create incoherent and disjointed half-units
- Marks spreadsheet gives overall performance during the year and alerts staff to poor performance in Scenarios and other coursework



# Assessment structure – 1<sup>st</sup> and 2<sup>nd</sup> years

- Students have to achieve an overall pass mark AND have passed all four Clusters to proceed
- Referral tests are held in September for students whose overall mark lies in the referral band 35%-39%
- Referral tests are held in September for students who fail more than one Cluster but have an overall mark of 40% or above
- “Condoned fails” are allowed for students with an overall mark of 40% or above if only one Cluster is failed with a mark 35%-39%
- Record of Achievement also maintained to monitor student performance in “core” engineering disciplines – useful for writing references

# Admissions

*Criteria are now AAA*

*No specific requirement for Mathematics, Physics, Chemistry or Biology;  
English language requirements need attention*



*Selection afternoons*

- mini-scenarios*
- tours of College*
- special interviews*

*The Birling Gap Question*

- to defend or not to defend?*

# Accreditation

- Civil and Environmental Engineering degrees are accredited by the Joint Board of Moderators: 2006 report supportive of changes
- CIWEM accredited Environmental Engineering degrees in 2009

## The results so far ....

- In the first year of the programmes, marks in Context and Mechanisms had to be weighted to balance average marks across Clusters – successful change introduced to exam format for subsequent years
- Students are far better at managing themselves in group work on the Land Survey Field Course than those of previous years
- Most students near the bottom of the class identified as having a problem with English language – additional remedial classes have reduced this problem
- Far more students are now engaged with Global Citizenship - “International Programmes” and voluntary work overseas
- Very much better performance overall, driven by better motivation

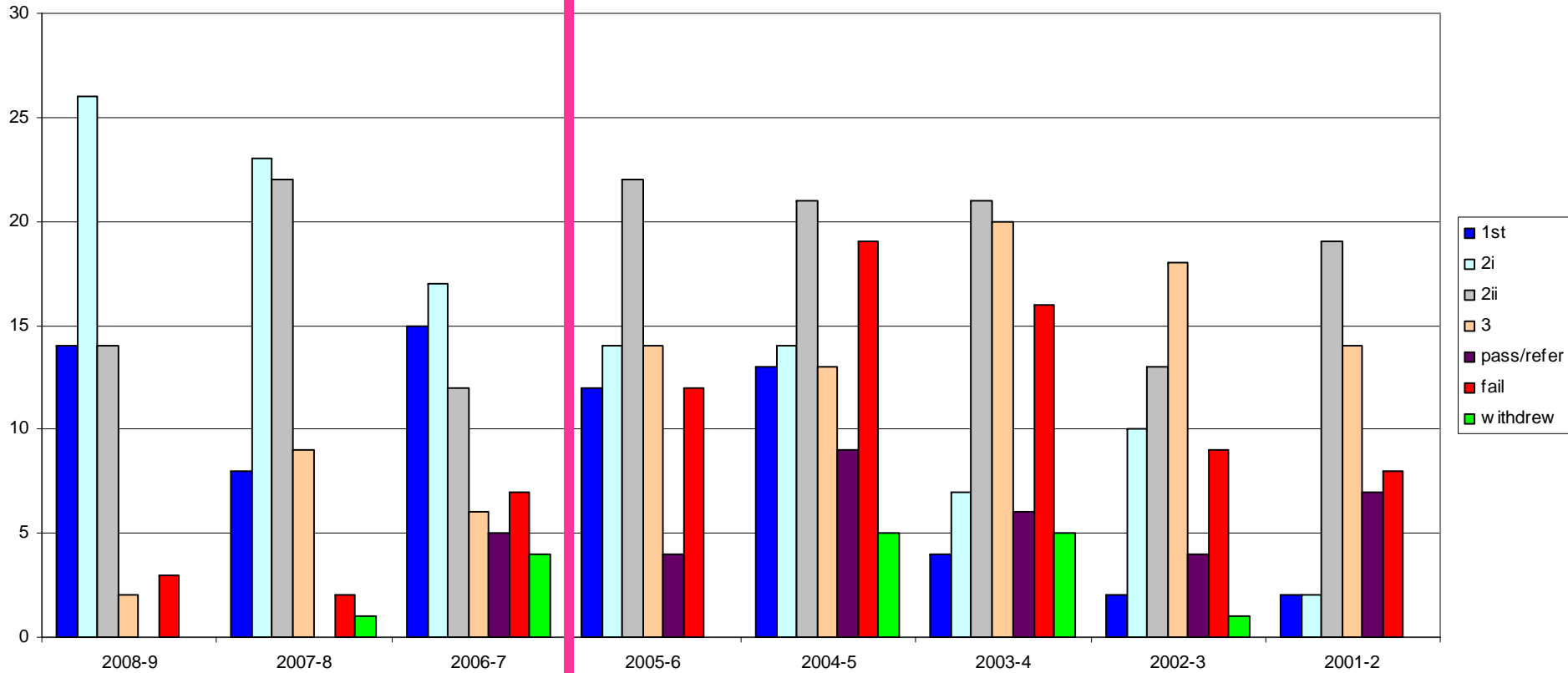
## The student view:

- Very positive about Scenarios – they are stressful, but “good stress”!
- Better guidance is needed to explain initially what is expected of students during each Scenario
- Make-up of groups and poor contributions from weaker or lazy students is seen as a problem
- Teaching sessions lasting three hours were considered too long
- Optional classes are required for maths, chemistry and biology – they would welcome a pre-sessional refresher course

## Negative views:

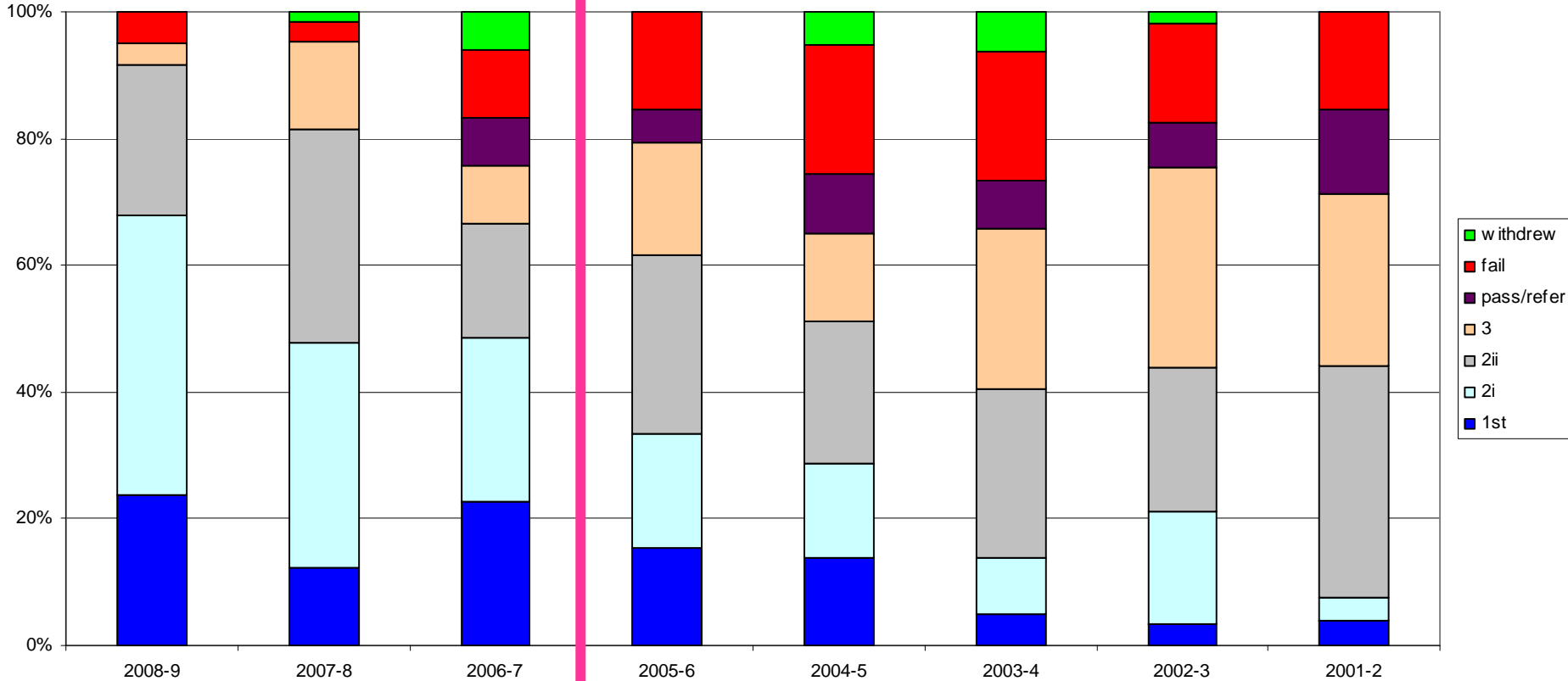
- Excessive workload
- Poor information flow
- Confusion when staff retire or change roles

1st year marks



**New** | **Old degree programmes**

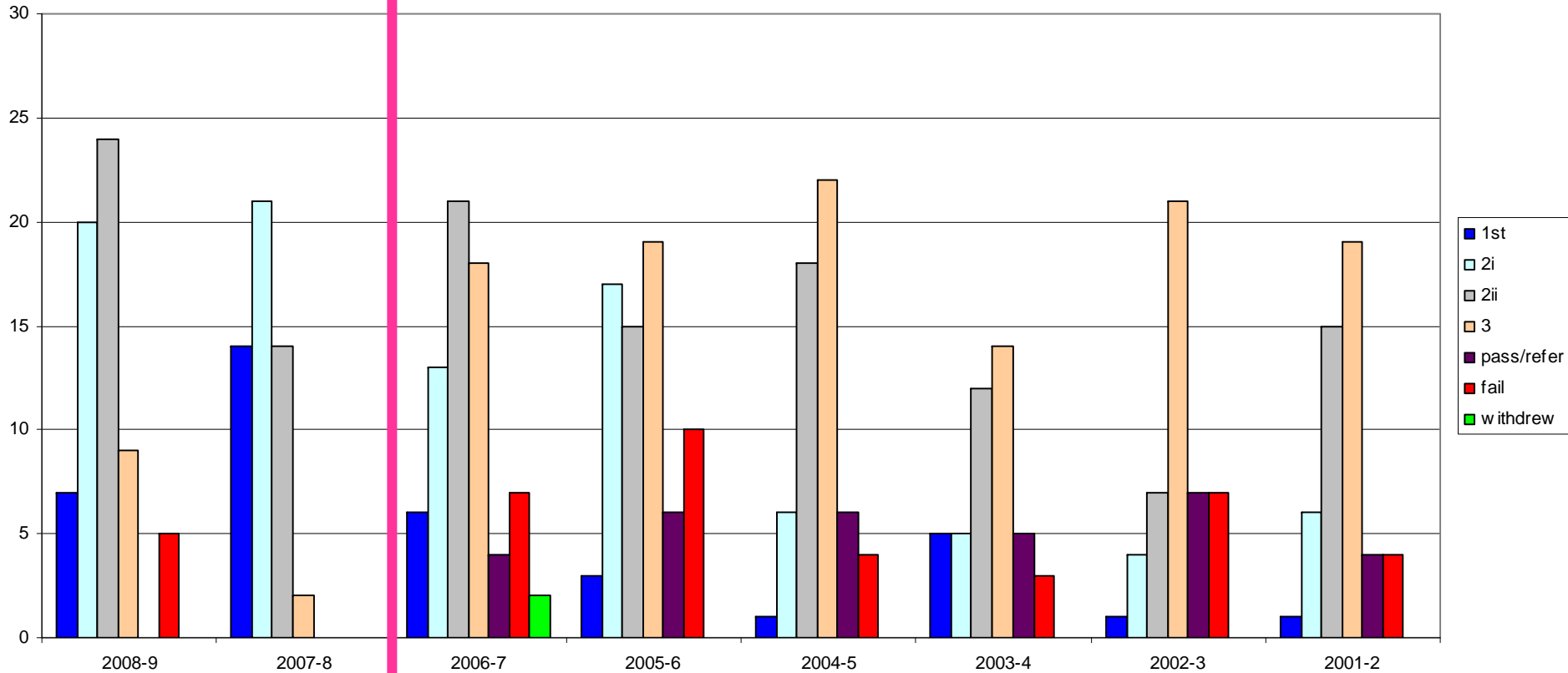
1st year marks



New

Old degree programmes

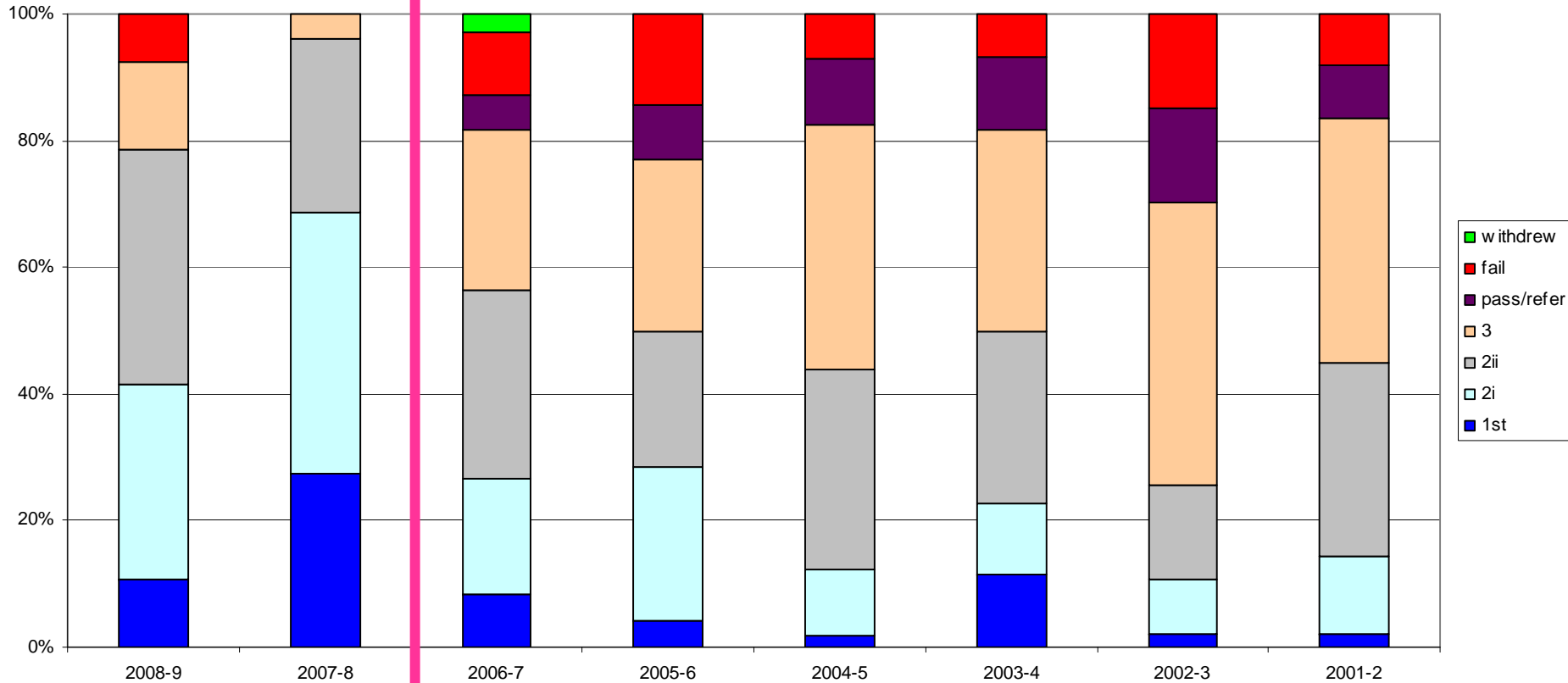
### 2nd year marks



**New**

**Old degree programmes**

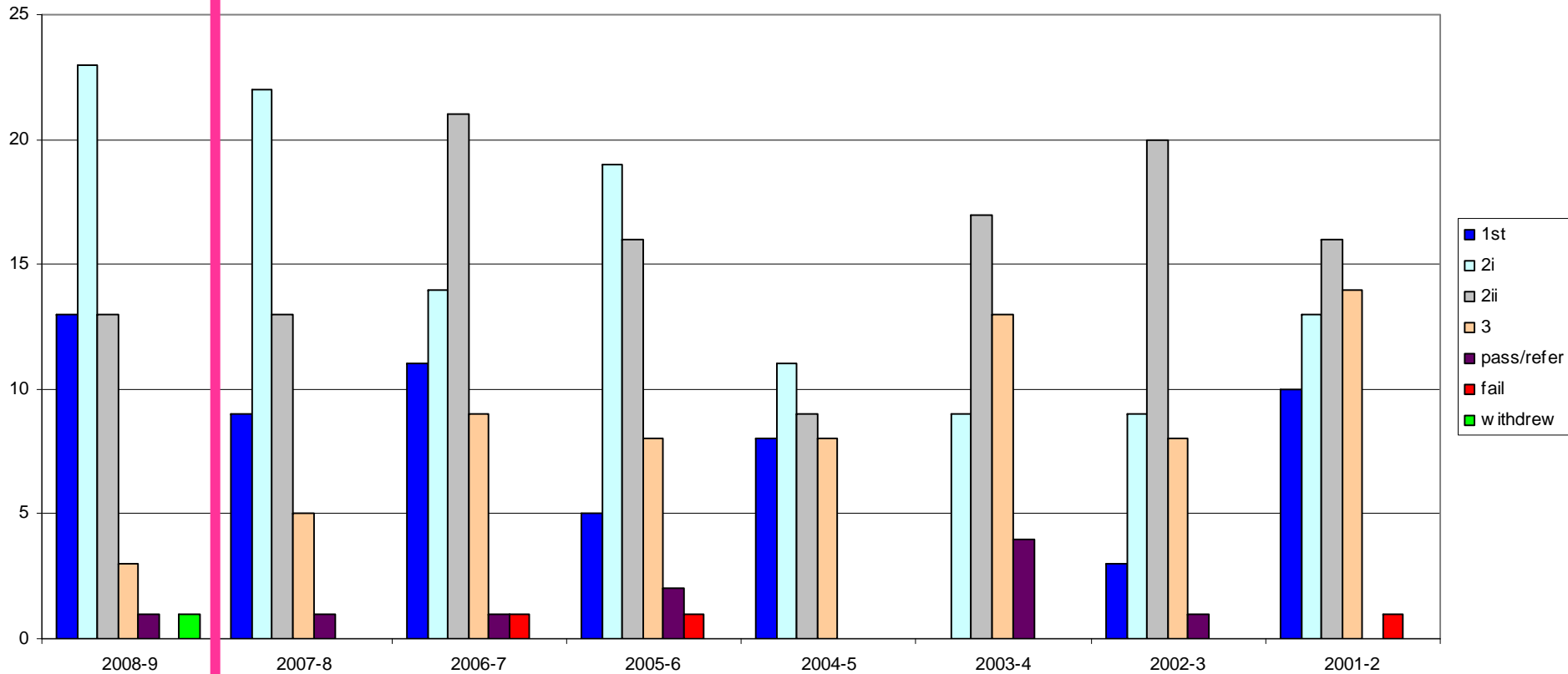
### 2nd year marks



**New**

**Old degree programmes**

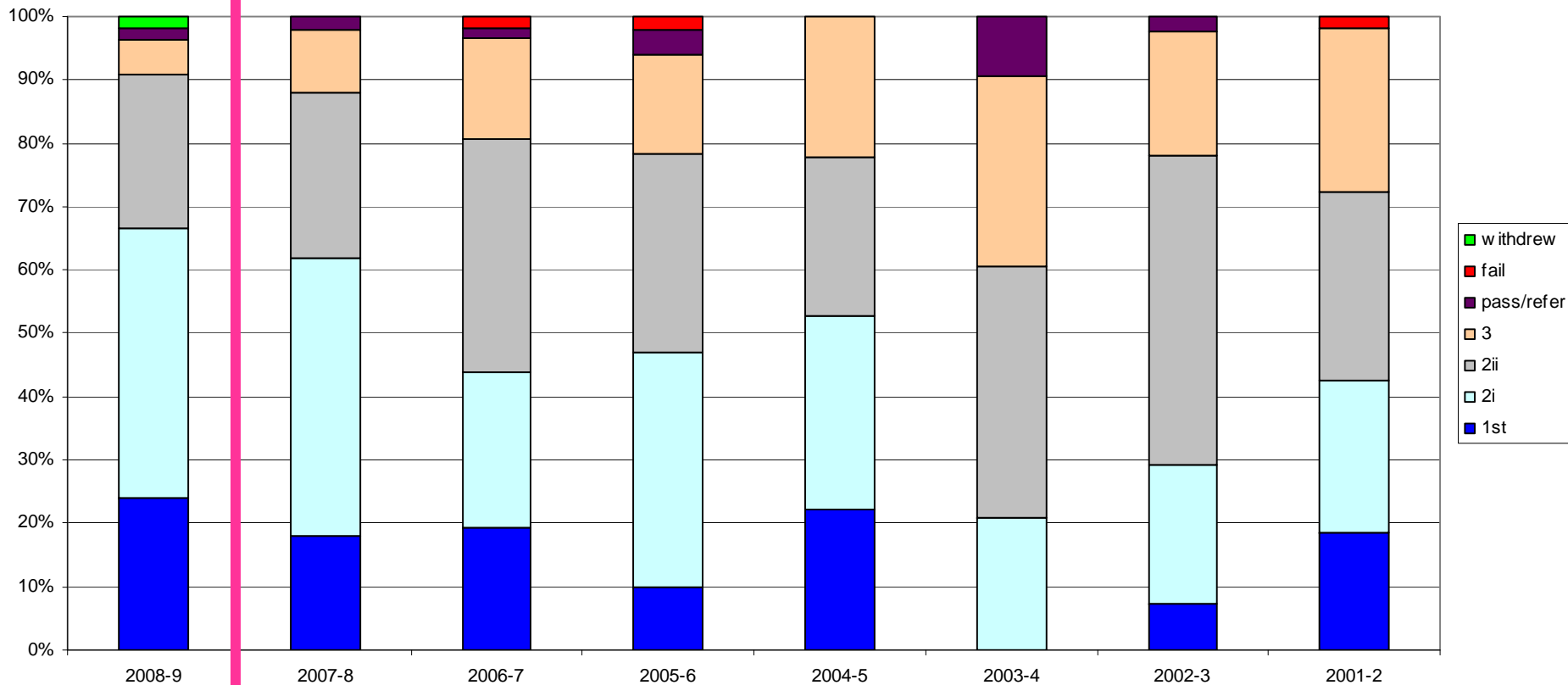
### 3rd year marks



**New**

**Old degree programmes**

### 3rd year marks

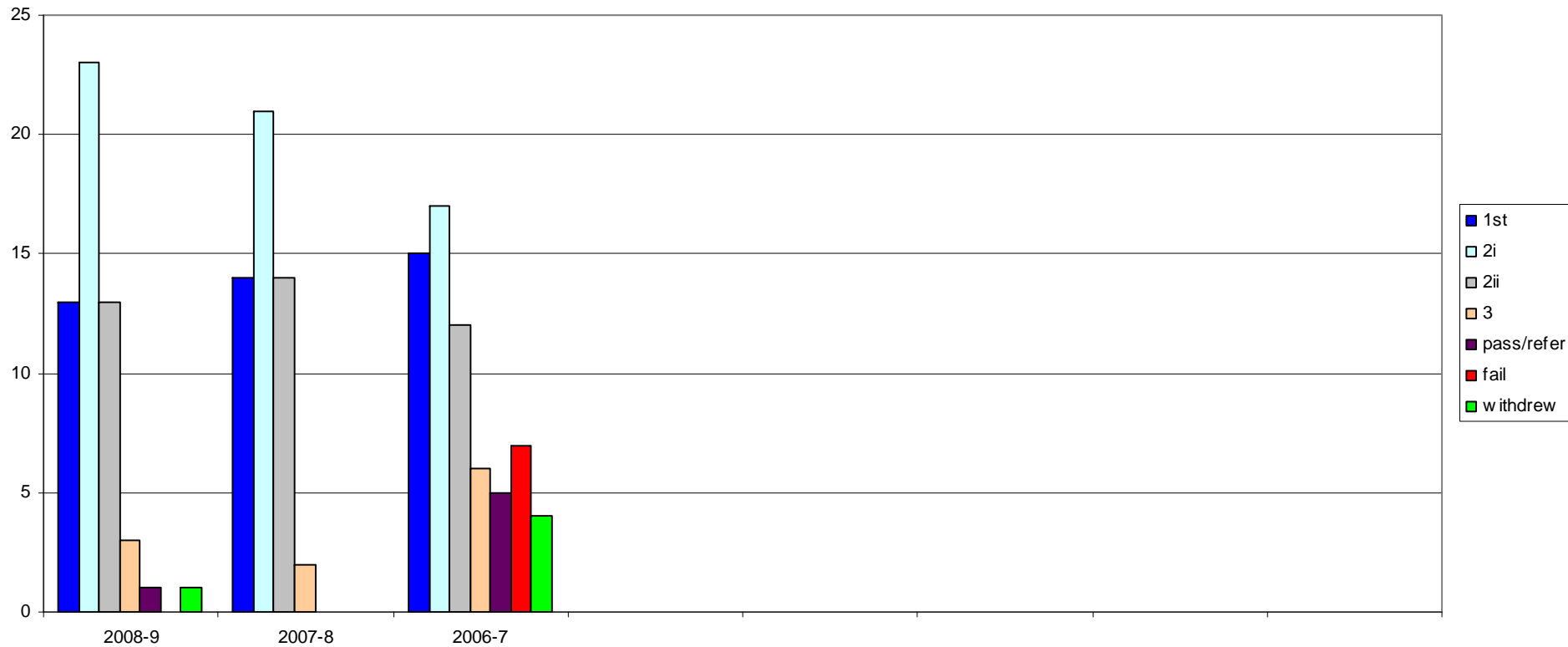


**New**

**Old degree programmes**

# Cohort mains performance across all 3 years

2006 Intake  
 - comparing their 1st, 2nd and 3rd year marks



# Summary

- Three A-grades are now required for entry to the new degrees
- Student performance is consistent across all years of study
- 1<sup>st</sup> year failure rate has fallen from 20% to under 5%
- 2<sup>nd</sup> year performance, traditionally weak, has been transformed
- Results from the 3<sup>rd</sup> year, which follows the traditional degree programme, are also improved
- Around 20% of the cohort choose to take their 3<sup>rd</sup> year abroad
- Even sceptical staff are positive about the new structure