THE WIDE ROLE OF INFORMATICS AT UNIVERSITIES

THE AUTHOR

1. Introduction

In the 1970s with the advent of the personal computer we entered into the Digital or Information Age. However it has only been in this century with the ubiquity of the internet, the smartphone, and the internet of things that digital has become truly pervasive. How do universities respond to this massive change? Informatics Europe established in 2018 a new working group to investigate what universities are doing to ensure that non-informatics teaching and research is informed by best practice in Informatics.

To better understand the state of affairs on this topic and discover best practices at European Universities, the working group conducted an online survey. We invited heads and members of Informatics/Computer Science/IT Departments (Schools, Faculties, Institutes) to complete a questionnaire. The request to fill out our survey was sent to all Informatics Europe members and it was also publicly available from the Informatics Europe website. The questionnaire was filled out autumn 2018. Forty eight universities (almost all IE members) from eighteen countries filled it out. The list of participants is in table 4.

Our survey was wide ranging. We wanted to understand how universities valued interdisciplinary research, about teaching Informatics to non-specialist students, what happens i n practice with hiring and supporting interdisciplinary academics. We wanted to know about how Data Science in particular fits into universities and finally the structures in place to support interdisciplinary work. The survey questions are in the Appendix A.

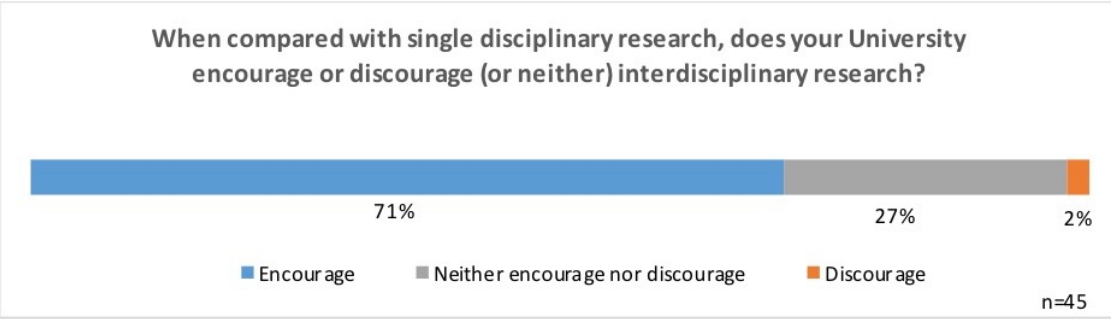
How Informatics (also called Computer Science or Computing) should position itself in a university is a political decision. The extremes we could imagine range from primarily being a service department to primarily being a research area that is isolated from other departments.

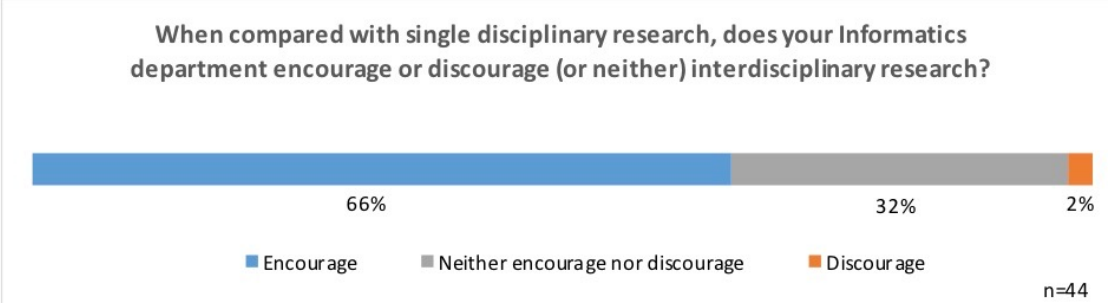
2. research

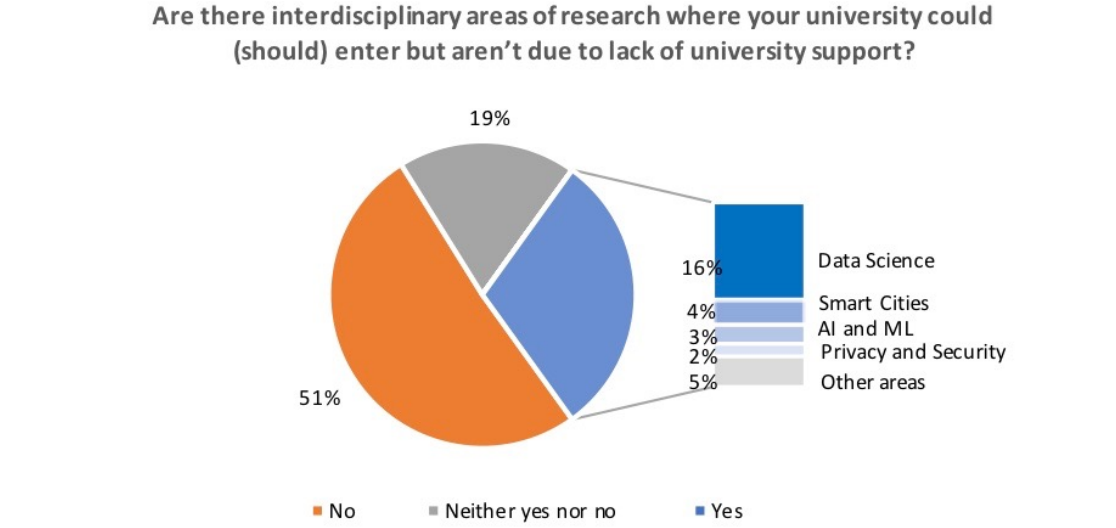
Luis Caires

	Country	**University**
1.	Austria	TU Wien
2.	Belgium	Université Catholique de Louvain
3.	Bulgaria	Sofia University St. Kliment Ohridski
4.	Czech Republic	Masaryk University
5.	Denmark	Aalborg University IT University of Copenhagen University of Southern Denmark
6.	Estonia	Tartu University
	Finland	Aalto University
7.	Germany	RWTH Aachen Humboldt-Universität zu Berlin Paderborn University of Stuttgart
8.	Hungary	Eötvös Lornd University
9.	Ireland	Technological University Dublin
10.	Italy	University of Bari Aldo Moro Università di Torino Alma Mater Studiorum - Universit di Bologna Università degli Studi di Milano Politecnico di Milano Università Roma Tre Università degli Studi di Milano-Bicocca Università degli studi "G. d' Annunzio" Chieti Pescara
11.	Latvia	University of Latvia Transport and Telecommunication University
12.	Netherlands	Delft University of Technology Tilburg University Utrecht University
13.	Portugal	Universidade Nova de Lisboa
14.	Romania	Babes-Bolyai Univ. Cluj-Napoca
15.	Spain	University of Almeria Universitat Politecnica de Catalunya University of Extremadura University Jaume I University of Málaga Complutense University of Madrid University Oviedo Universidad de Valladolid
16.	Sweden	Chalmers — Gothenburg University
17.	Switzerland	University of Bern EPFL University of Lugano ETH Zürich University of Zürich
18.	UK	Cambridge University University of Edinburgh Imperial College London University of Oxford

TABLE 1. Participating Universities

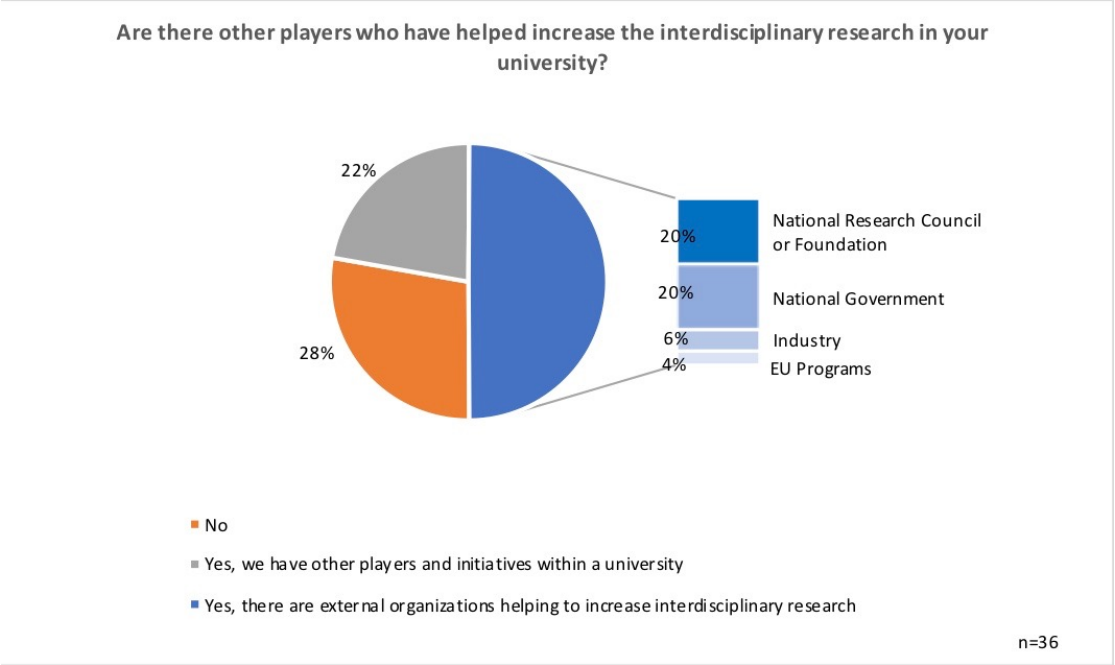


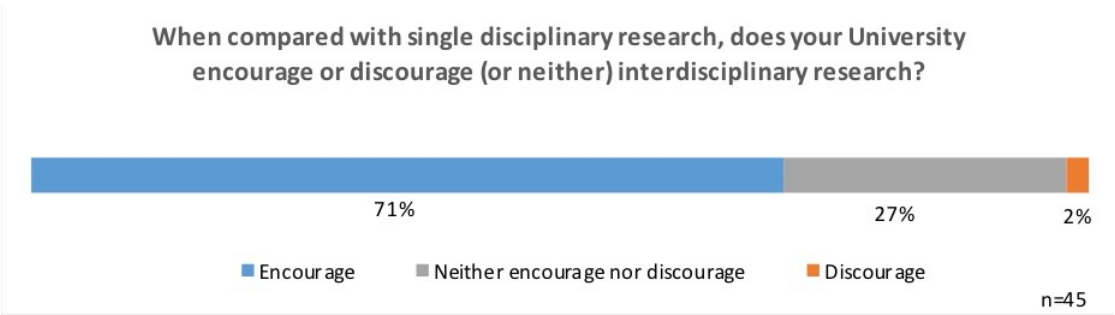




Data Science: Applied Statistics, Bioinformatics, Biomedical Data Science, Data Analysis, Digital Health, Predictive/Precision Medicine
Smart Cities: Data-driven Economy, Smart Building, Remote Sensing, , Energy Management
Other areas: Design Interaction, Game Research, Quantum Computing, Informatics for Environmental Sciences

n=37

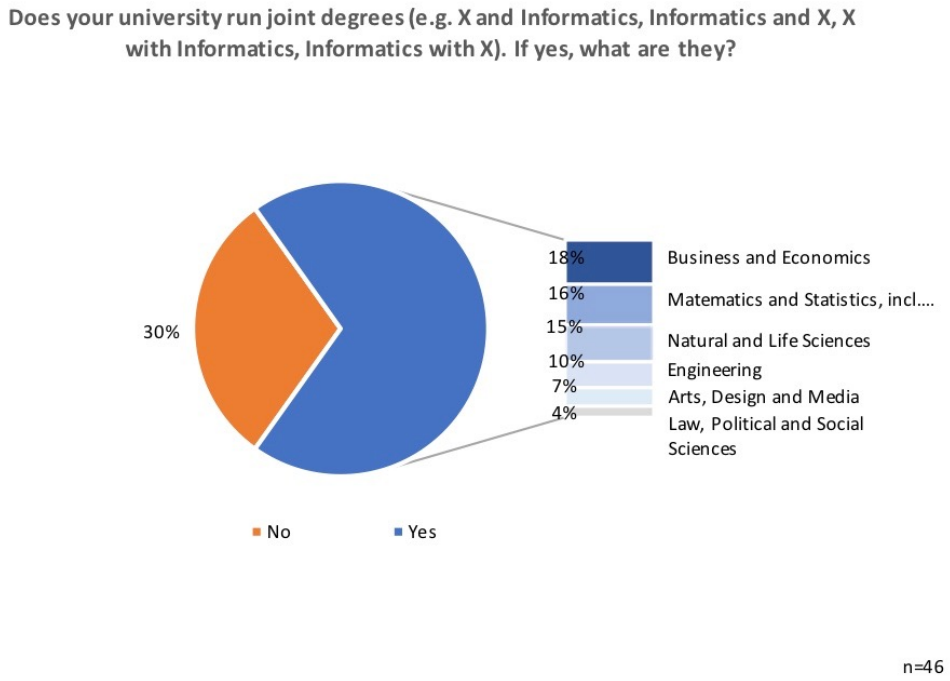




3. TEACHING

Inmaculada Garcia Fernandez

4. 2.A. Does your university run joint degrees (e.g. X and Informatics, Informatics and X, X with Informatics, Informatics with X). If yes, what are they?



Only 30% of the universities does not run a joint degree including Informatics.Within this group of universities, some of them specify that all their programs entails to some extend technical aspects of IT, like programming or data base technology or there are some joint programmes, e.g. a Data Science BSc programme that joins CS, Math and Industrial Engineering, and an MSc major in Game Design and Production jointly with the Arts School, but these are collaborative initiatives in new directions, where the CS Department is one of the partners; the Business School has their own small Informatics programme.

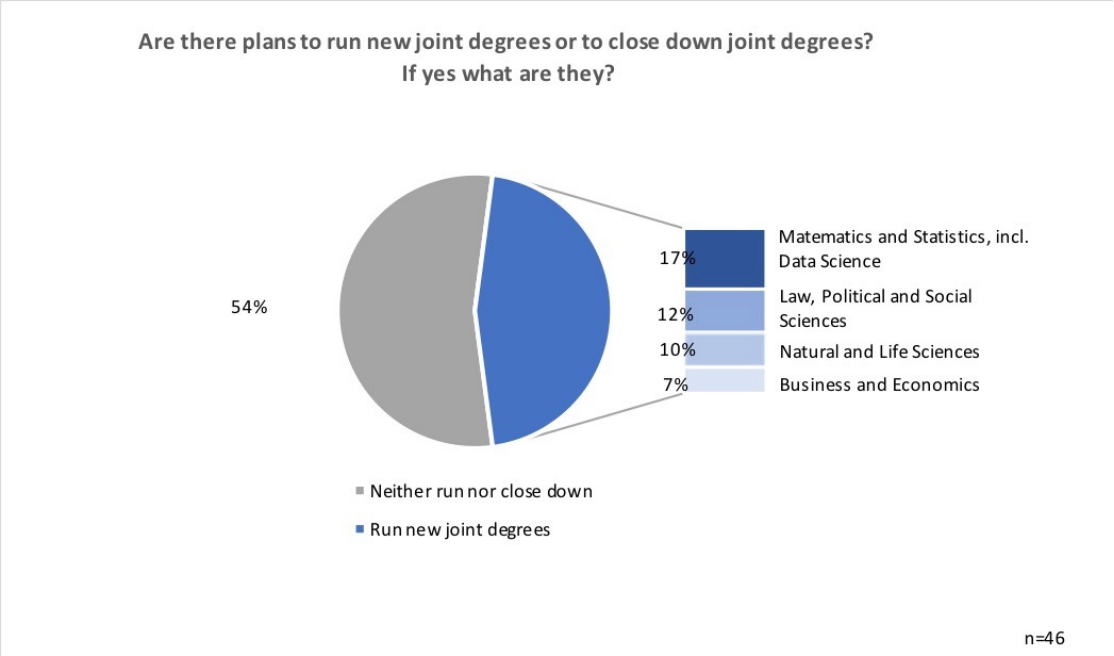
The remaing 70% of the universities run some joint degrees, the most popular joint degrees including Informatics are Business and Economics (Business Informatics; CS and Business; Computing and Economics; Information systems combining Informatics and Business Administration; CS and Management; Informatics and Economics; Informatics and Finance; Economics and Business Informatics; Data Science and Entrepreneurship) followed by Mathematics and Statistics (Informatics and Mathematics; Data Science; Informatics and Applied Mathematics; Informatics and Statistics), Natural and Life Sciences (Bioinformatics; Informatics and Natural Sciences; CS and Physics; AI for Biomedicine; Precision Medicine; Geoinformatics; Chemistry and Informatics; Biology and Informatics; Informatics Health) and Engineering (Computational Engineering; Computer Engineering; Electronics and Information Engineering; Informatics and Electronics; Informatics and Telecommunications; Informatics and Cybernetics; Informatics

Level	**Joint title**	**Countries**
BSc	Economy and Computer Science	Spain, Switzerland
BSc	Economics and Business Informatics	Italy, Switzerland
BSc	Business informatics	Austria, Czech, Germany Italy, Switzerland, UK, Denmark
BSc	Informatics and Management	Italy, UK
BSc	bioinformatics,	Czech, Denmark, Italy, Switzerland
BSc	Geoinformatics	Italy
BSc	informatics and Mathematics	Netherlands, Spain, UK
BSc	Informatics and Statistics	Spain
BSc	Informatics and Physics	Spain, UK
BSc	Law and informatics	Czech
BSc	Social sciences and informatics	Czech
BSc	Technical Communication	Germany, Denmark
BSc	Computational Engineering	Germany
BSc	Cybernetic	Germany
BSc	Mechatronic	Germany
BSc	INFOTech	Germany
BSc	Information Science /Library science	Germany
BSc	Data Science	Italy, Spain
BSc	ICT and Media	Italy
BSc	Data Science and Entrepreneurship	Netherlands
BSc	Data Science and Society	Netherlands
BSc	Cognitive Science and Art. Intellig.	Netherlands
BSc	Informatics Health	Spain
BSc	Informatics and Engineering	Spain, UK
MSc	Data mining with political Sc.	Italy
MSc	Informatics and Psychology	Italy
MSc	Comput. Sc. and Engineering	Switzerland
MSc	Bioinformatics	Switzerland
MSc	Design Informatics	UK, Denmark

TABLE 2. Joint degrees (BSc and MSc) and countries

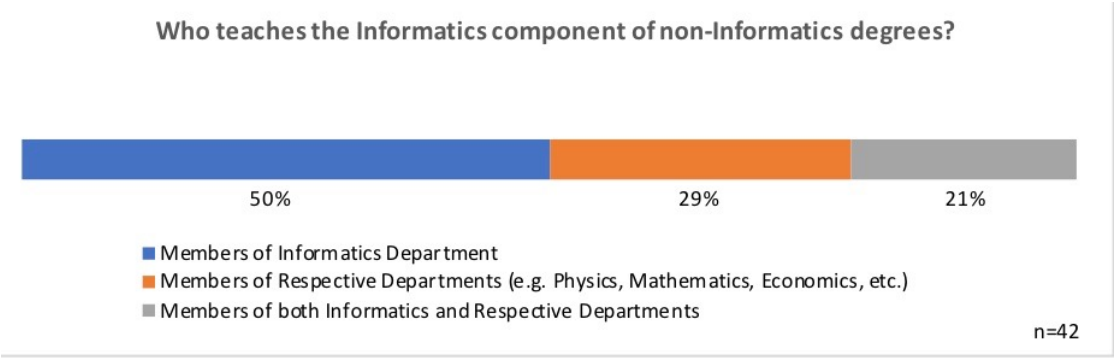
and Mechatronics; Informatics and Aerospace Engineering; Informatics and Civil Engineering; Informatics and Industrial Engineering). Joint degrees in informatics plus Arts, Design and Media (Technical Communication; Design Informatics; CS and communication, CS and design; ICT and media; Informatics and information science; Informatics and library science) or Law, Political and Social Sciences (Law and Informatics; Social sciences and Informatics; Data mining for political sciences; Informatics and Psychology; Data science and society; Cognitive Science and AI) are not very frequent at the consulted universities, they represent only the 11% of the cases. Table 2 summarizes the joint degrees (BSc. and MSc) offered by one or more universities and the countries where they are located.

5. 2.B. Are there plans to run new joint degrees or to close down joint degrees? If yes what are they?



In general, the situation is quite stable for those universities that are currently offering joint degrees. Most of the universities not already offering joint degree show a significative interest in running new joint degrees. The most popular joint degrees to be run in the future are in the subject of Mathematics and Statistics for which at least eight universities have shown interest (IT University of Copenhagen, University of Edinburgh, University of Oviedo, Aalborg University, Paderborn, University of Malaga, University of Southern Denmark, Humboldt-Universitt zu Berlin), followed by the subject of Natural and Life Sciences (University of Bern, University of Stuttgart, University of Lugano, Humboldt-Universitt zu Berlin) and Law, social and political sciences (RWTH Aachen, Etvs Lornd University, University of Edinburgh, University of Stuttgart, Paderborn) and finally the area of Business and Economics (University of Edinburgh, University of Bari "Aldo Moro", Tilburg University).

6. 2.C. Who teaches the Informatics component of non-Informatics degrees? For example, is programming taught to Physicists by members of the Physics department, of the Informatics department or is there a servicing organisation within your university that teaches Physics students to code (or some other mechanism)?

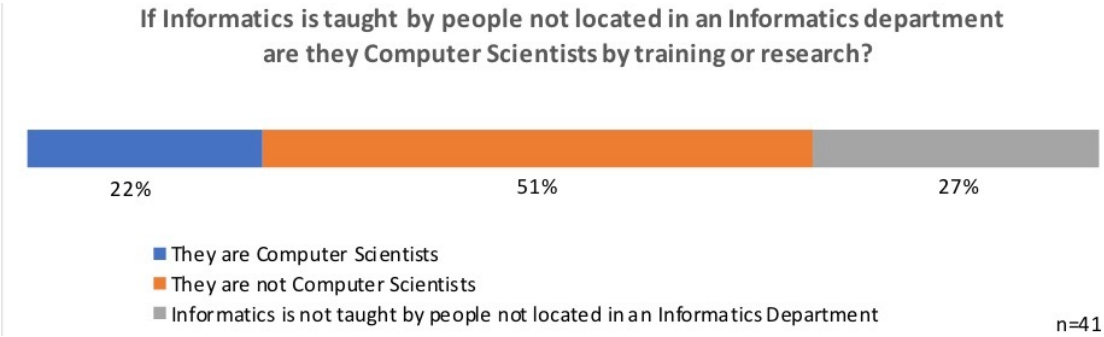


The results of the survey indicates that half of the universities (50%) give the responsability of teaching informatics subjects fo non-informatics degrees to members of the Informatics department. And additional 21% of the universities the responsability of teaching Informatics is shared amog the Informatics department and other departments involved in the joint degree; some of the universities specify that only the general/basic subjects related to the Informatics of non-Informatics degrees are taught by Informatics department (for example programming) but when the subject is related to any particular contents of the degree and the informatics, then the subject is taught by the teachers with profile related with the specific degree. For example, the Bioinformatics of the Biotechnology degree is taught by Chemists. In other universities, informatics component of non-informatics degree programmes is sometimes taught by the informatics department, especially the more advanced levels. Some of the informatics departments have not enough human resources to acquire teaching responsabilities for non-Informatics degrees . A significative percentage of the unversities consulted (29%) recognize that informatics components of joint degrees are taught by other departments such as Physics, Mathematics, Economics, etc., depending on the subject of the joint degree.

7. 2.D. If Informatics is taught by people not located in an Informatics department are they Computer Scientists by training or research?

A very low percentage of the answers (27%) corresponds to universities where the informatics is always taught by teachers located at an informatics department. Nevertheless, an additional 22% of the answers specify that the informatics is taught by Computer Scientists. Most of the universities participant in the survey recognize that persons who teach informatics for students of non-informatics degree does not have a background in Computer Science (51%). Usually, when the Informatics subjects are taught by non Computer Scientists, the teachers have a background formation in the same degree the students are following; e.g. electrical engineers at the Electrical Engeneering Schools,

Economics/Management people at the Business School, Physists or Engineers at Robotics or Industrial engineering degrees. Additionally, in some universities the basic informatics courses are taught by non Computer Scientists.



8. 2.E. Please comment on any advantages or disadvantages you perceive of your universitys arrangements.

The casuistry of the answers is really broad. For some universities there exits a clear discipline-responsibility (e.g. Paderborn) but in others there is no clear regulations about the department teaching informatics in non-informatics programmes (e.g. RWTH Aachen); lacks of human resources prevent the informatics departments to be in charge of teaching informatics subjects in non-informatics degree programmes (e.g. Utrecht University, Universit Roma Tre, University of Bari "Aldo Moro", Tilburg University)

9. people

Elisabetta Di Nitto

The purpose of this section in the survey was to investigate the situation concerning the possibility to hire multidisciplinary researchers and promote their career and development. The following subsections discuss the answers obtained for each specific question. In general, it is possible to affirm that the situation, even if significantly different from case to case, reveal a significant level of immaturity that will have to be overcome in the near future. The good news is that some universities, even if in a non-completely structured way, are investing significant effort to increase the presence of interdisciplinary faculties in research and teaching staff. More time is certainly needed to assess the effects of these investments and to see a change in the most conservative countries in Europe.

9.1. **3.A Does your university explicitly advertise/hire academics who focus on interdisciplinary research?**

63% of the respondents have affirmed that their university does not explicitly hire interdisciplinary researchers (see Figure 9.1). In Italy this is due to the organization of research areas in distinct *scientific sectors*, which are mostly related to a single discipline and cannot be easily revised to follow the advances of research and technology. Spain appears to show similar problems.

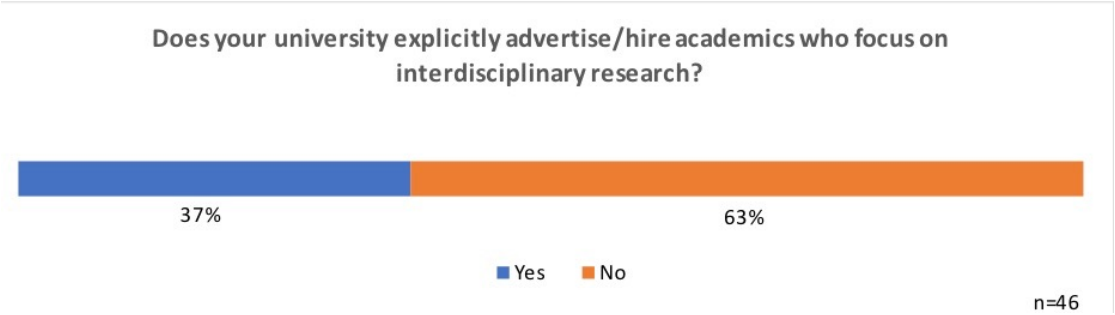


FIGURE 1. Interdisciplinary hirings.

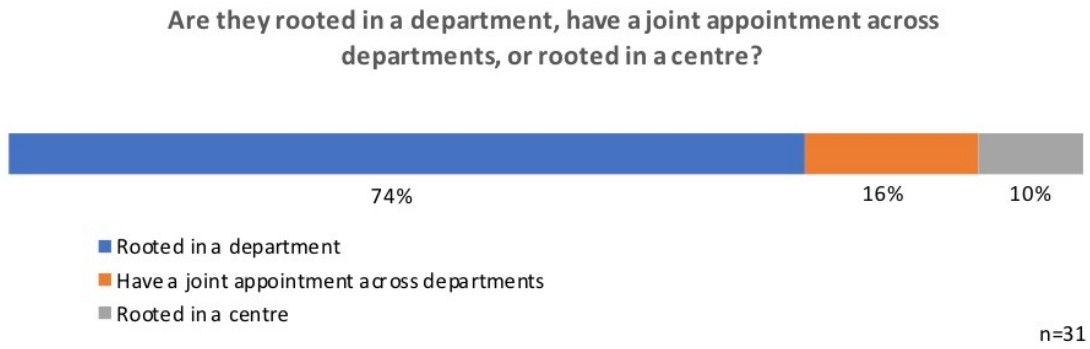


FIGURE 2. Affiliation of interdisciplinary faculties.

Among the 37% of positive respondents, some identify bioinformatics as one of the areas where multidisciplinary researchers are hired. Other identified areas concern man-machine interaction, medical informatics, AI/data science, and media informatics/game design.

9.2. **3.B Are they rooted in a department, have a joint appointment across departments, or rooted in a centre?** In 74% of the cases, multidisciplinary researchers are rooted within a department (see Figure 9.2). According to the comments associated to this question, this seems to be due to the need to assign every faculty to a specific department. The respondents, however, note that such researchers spend also part of their time in a multidisciplinary centre or in another department.

9.3. **3.C How is their quality judged for both appointment and for promotion?** As shown in Figure 9.3, there is an equal distribution between universities where the appointment/promotion assessment is performed at the department level and universities where this happens across departments. Analysing the specific comments by the respondents, it is difficult to find common patterns as the mechanisms for appointing and promoting faculties appear to vary significantly from country to country.

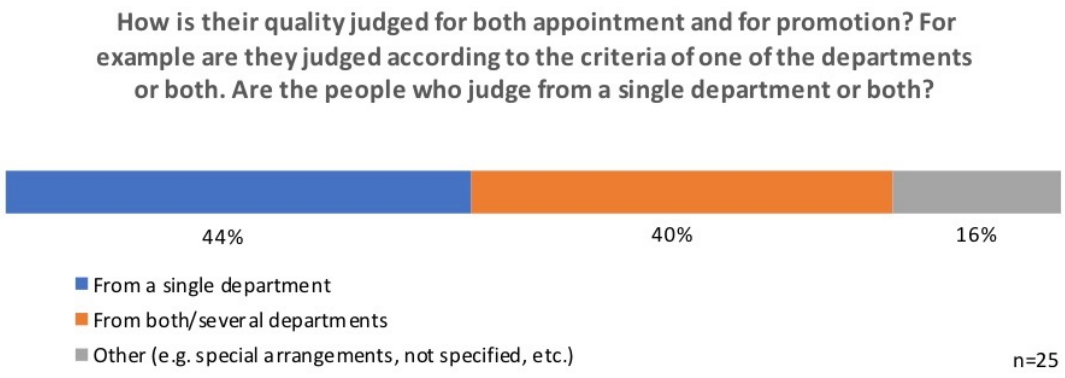


FIGURE 3. Assessment of interdisciplinary faculties.

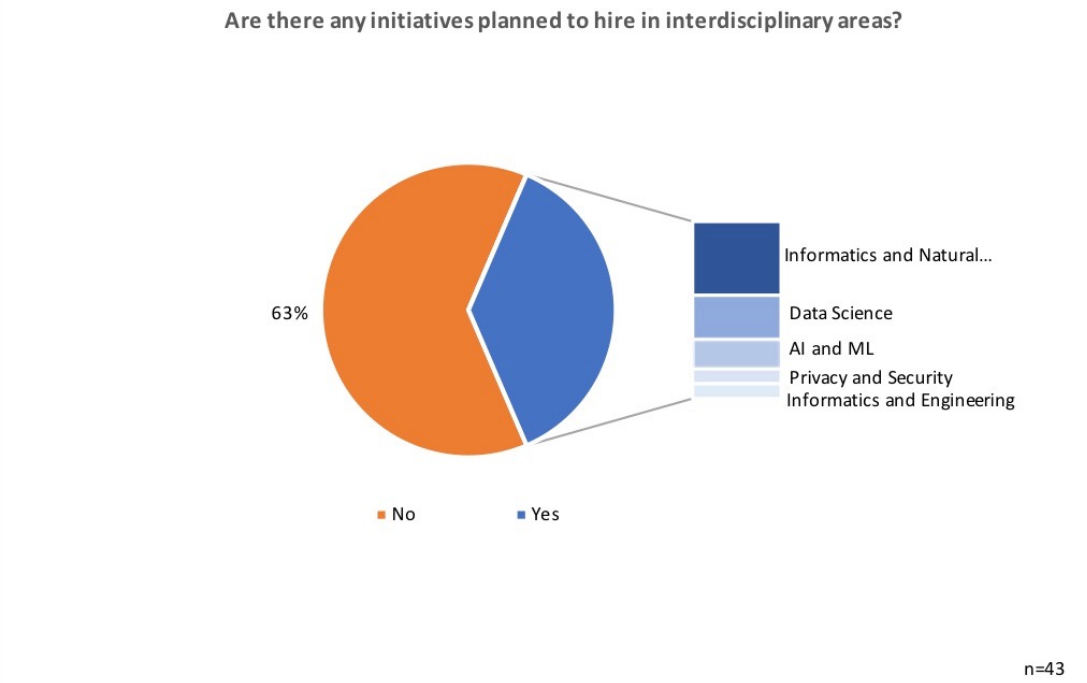


FIGURE 4. Planned initiatives concerning multidisciplinary hirings.

9.4. **3.D Are there any initiatives planned to hire in interdisciplinary areas?** As shown in Figure 9.4, the answer to this question appear to be quite similar to the ones discussed in Section 9.1. Also in this case, 63%of respondents do not see any plan to hire multidisciplinary researchers while among those who see these plans in place natural life and science and, in particular, bioinformatics, appear to be the most targeted field.

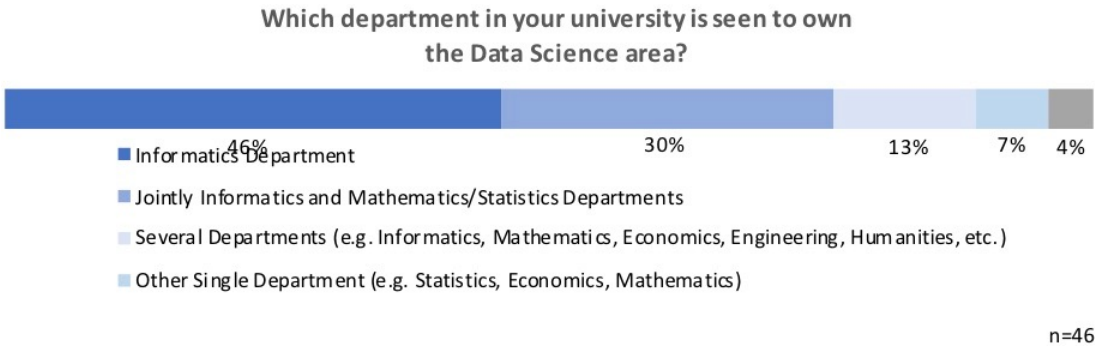
9.5. **3.E Please comment on any advantages or disadvantages you perceive of your university's arrangements.** The answers to this question show that the

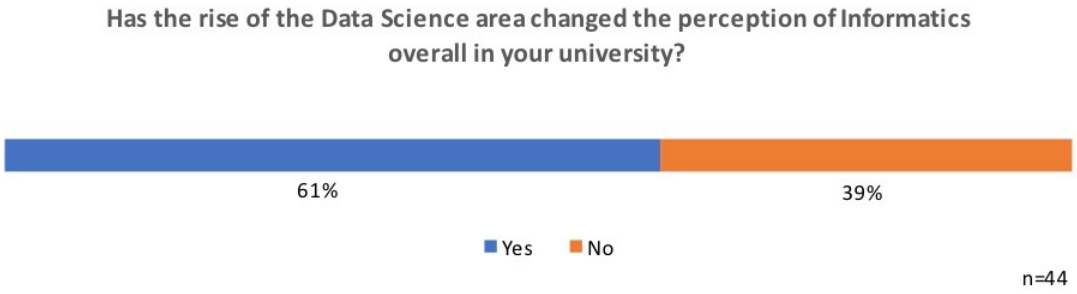
situation is still quite immature. In the cases where universities are largely autonomous from national agencies, hiring interdisciplinary researchers is encouraged when there is some funding, often by third parties, dedicated to this. Even in this case, respondents highlight the difficulty of comparing researchers with different background and skills and the current lack of complete understanding of the phenomenon given the limited number of multidisciplinary researchers that are currently in the system.

Respondents from countries where the hiring system is strongly regulated by some national agency, highlight the difficulty to introduce some flexibility and to define long-term plans which include multidisciplinarity as an important aspect.

10. Data Science

Eduard Groller

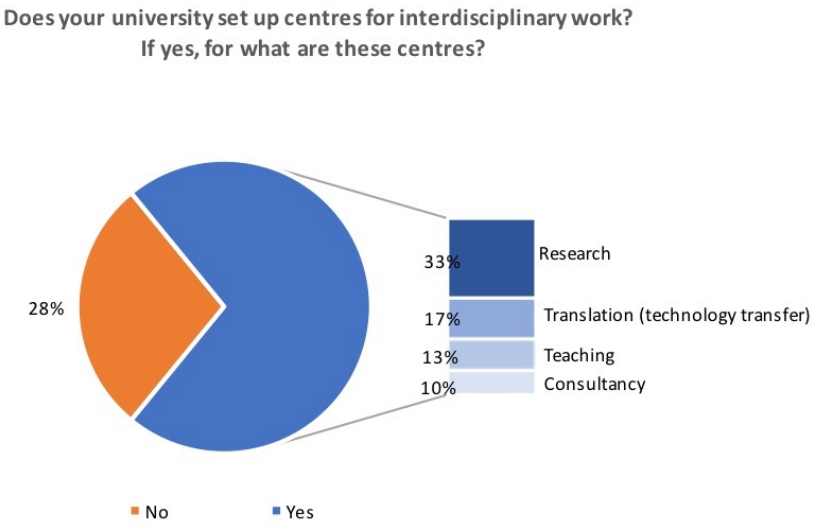




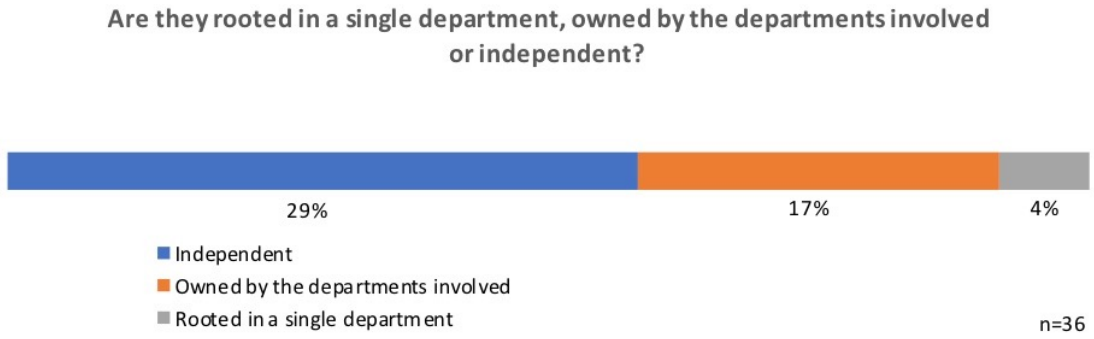
11. structure

Luis Caires

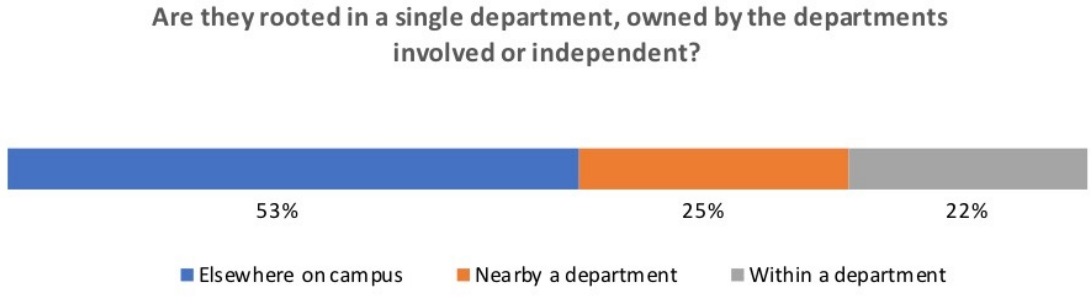
Inmaculada Garcia Fernandez


Does your university set up centres for interdisciplinary work?
If yes, for what are these centres?
28%
33%
Research
17%
Translation (technology transfer)
13%
Teaching
10%
Consultancy
No
Yes

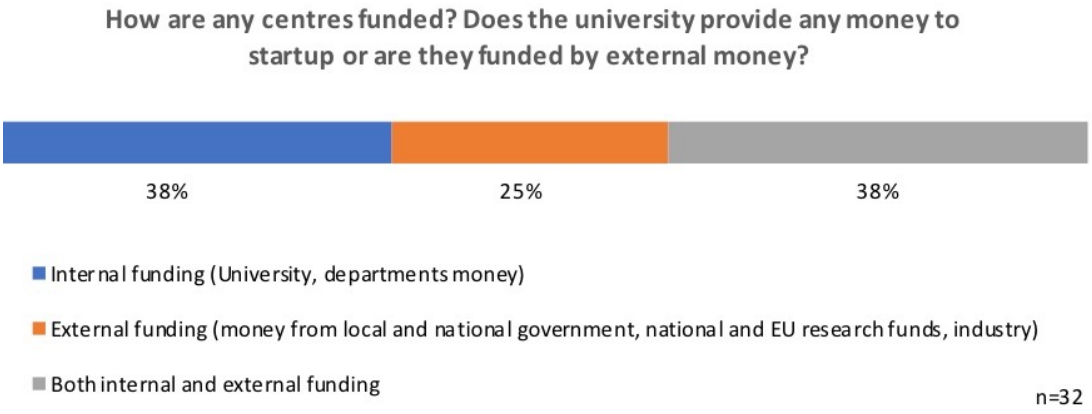
n=46

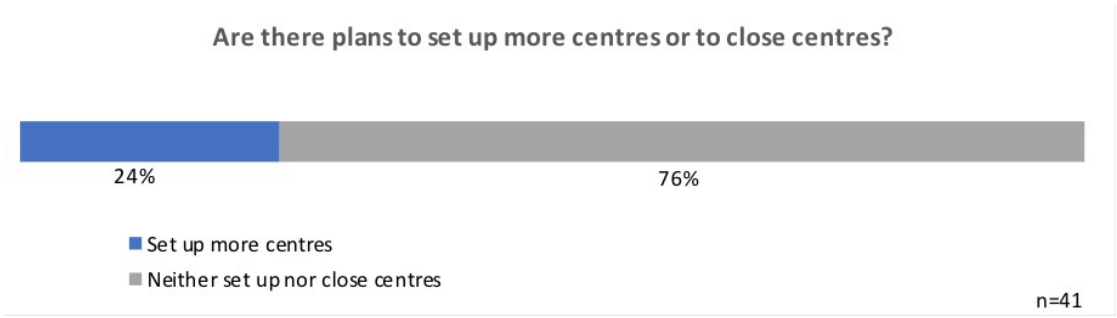

Are they rooted in a single department, owned by the departments involved or independent?
29%
17%
4%
Independent
Owned by the departments involved
Rooted in a single department

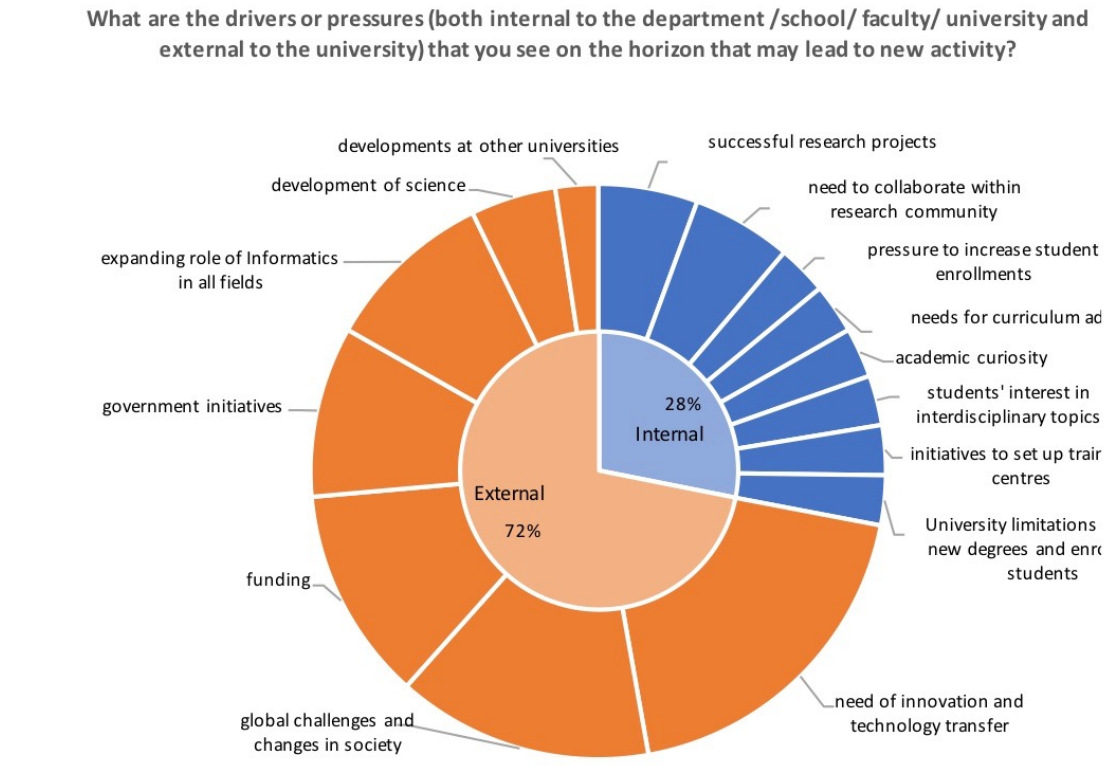
n=36

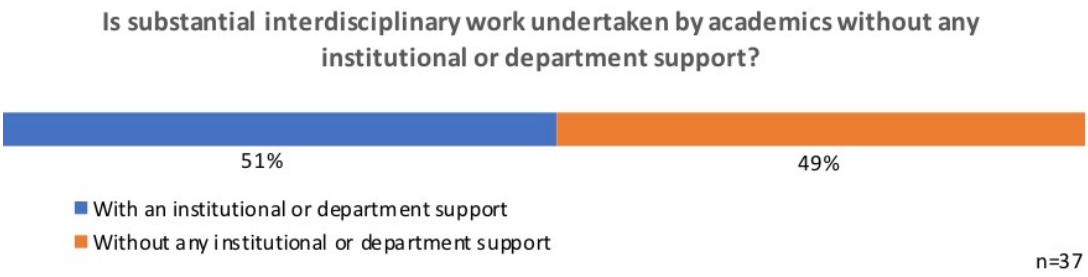

Are they rooted in a single department, owned by the departments involved or independent?
53%
25%
22%
Elsewhere on campus
Nearby a department
Within a department

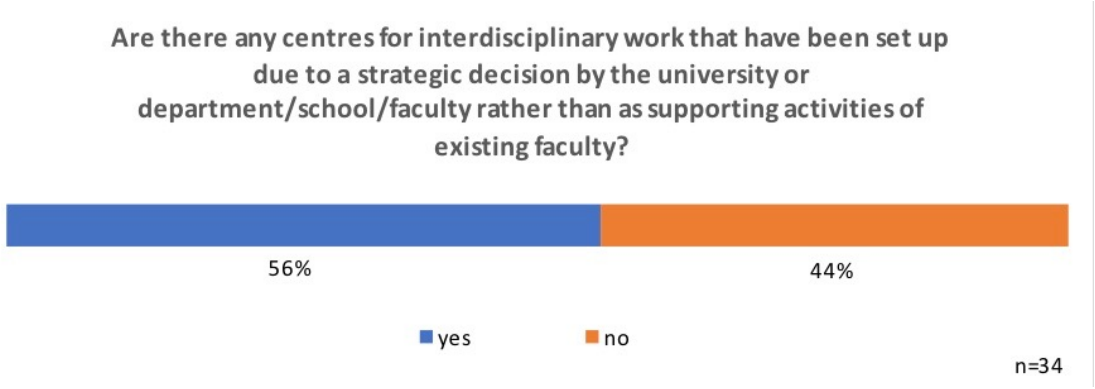
n=36

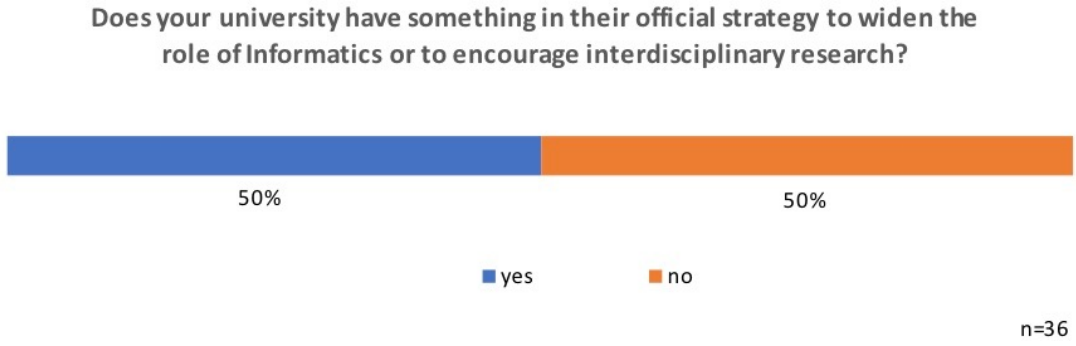

How are any centres funded? Does the university provide any money to startup or are they funded by external money?
38%
25%
38%
Internal funding (University, departments money)
External funding (money from local and national government, national and EU research funds, industry)
Both internal and external funding
n=32


Are there plans to set up more centres or to close centres?
24%
76%
Set up more centres
Neither set up nor close centres
n=41


What are the drivers or pressures (both internal to the department /school/ faculty/ university and external to the university) that you see on the horizon that may lead to new activity?
developments at other universities
successful research projects
development of science
need to collaborate within research community
expanding role of Informatics in all fields
pressure to increase student enrollments
needs for curriculum ad
academic curiosity
students' interest in interdisciplinary topics
government initiatives
28%
Internal
initiatives to set up trair centres
External
72%
University limitations new degrees and enr students
funding
need of innovation and technology transfer
global challenges and changes in society


Is substantial interdisciplinary work undertaken by academics without any institutional or department support?
51%
49%
With an institutional or department support
Without any institutional or department support
n=37


Are there any centres for interdisciplinary work that have been set up due to a strategic decision by the university or department/school/faculty rather than as supporting activities of existing faculty?
56%
44%
yes
no
n=34


Does your university have something in their official strategy to widen the role of Informatics or to encourage interdisciplinary research?
50%
50%
yes
no
n=36

Appendix A. Survey: The Wide Role of Informatics at Universities

(1) Research

   (a) When compared with single disciplinary research, does your university encourage or discourage (or neither) interdisciplinary research? If so how? (e.g. funding, time, physical centres) Encourage Discourage Neither encourage nor discourage

   (b) Does your Informatics department encourage or discourage (or neither) interdisciplinary research? If so how? Encourage Discourage Neither encourage nor discourage

   (c) Are there interdisciplinary areas of research where your university could (should) enter but aren?t due to lack of university support? If so what are they?

   (d) Are there other players who have helped increase the interdisciplinary research in your university? For example has a funding body focused a programme on interdisciplinary PhD studentships which academics applied for?If so what external organisations and what programmes have increased interdisciplinary research at your university?

   (e) Please comment on any advantages or disadvantages you perceive of your university?s arrangements.

(2) Teaching

   (a) . Does your university run joint degrees (e.g. X and Informatics, Informatics and X, X with Informatics, Informatics with X). If yes, what are they? Yes No

   (b) Are there plans to run new joint degrees or to close down joint degrees? If yes what are they? Run new joint degrees Close down joint degrees Neither run nor close down

   (c) Who teaches the Informatics component of non-Informatics degrees? For example, is programming taught to Physicists by members of the Physics department, of the Informatics department or is there a servicing organisation within your university that teaches Physics students to code (or some other mechanism)?

   (d) If Informatics is taught by people not located in an Informatics department are they Computer Scientists by training or research? They are Computer Scientists They are not Computer Scientists Informatics is not taught by people not located in an Informatics department

   (e) Please comment on any advantages or disadvantages you perceive of your university?s arrangements.

(3) People

(a) Does your university explicitly advertise/hire academics who focus on interdisciplinary research? Yes No

(b) Are they rooted in a department, have a joint appointment across departments, or rooted in a centre? Rooted in a department Have a joint appointment across departments Rooted in a centre

(c) How is their quality judged for both appointment and for promotion?For example are they judged according to the criteria of one of the departments or both? Are the people who judge from a single department or both?

(d) Are there any initiatives planned to hire in interdisciplinary areas? Yes No

(e) Please comment on any advantages or disadvantages you perceive of your university?s arrangements.

(4) Data Science

(a) Which department in your university is seen to own this area? Is it Informatics, Statistics, jointly or somewhere else? Informatics Department Statistics Department Jointly Informatics and Statistics Department Somewhere else (please specify)

(b) Has the rise of this area changed the perception of Informatics overall in your university? Yes No

(c) Please comment on any advantages or disadvantages you perceive of your university?s arrangements.

(5) Structure

(a) Does your university set up centres for interdisciplinary work? If yes can you say which they are? Yes No

(b) Are they for research, translation (technology transfer), consultancy, and/or teaching? Research Translation (technology transfer) Consultancy Teaching

(c) Are they rooted in a single department (say which one), owned by the departments involved or independent? Rooted in a single department Owned by the departments involved Independent

(d) Are they physically located within a department, nearby or elsewhere on campus? Within a department Nearby a department Elsewhere on campus

(e) How are any centres funded? Does the university provide any money to startup or are they funded by external money? Does the university provide longer term money?

(f) Are there plans to set up more centres or to close centres? If so what will they be? Set up more centres Close centres Neither set up nor close

(g) What are the drivers or pressures (both internal to the department/ school/faculty/universit and external to the university) that you see on the horizon that may lead to new activity?

(h) Is substantial interdisciplinary work undertaken by academics without any institutional or department support? Without any institutional or department support With an institutional or department support

(i) Are there any centres for interdisciplinary work that have been set up due to a strategic decision by the university or department/school/faculty rather than as supporting activities of existing faculty? If so which centres?

(j) Does your university have something in their official strategy to widen the role of Informatics or to encourage interdisciplinary research? If so what is it?

(k) Please comment on any advantages or disadvantages you perceive of your university?s arrangements.

(l) Is there anything we have missed in the survey that you wish to tell us?