

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 in autumn 2018. 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. For the location of the respondents see Figure 1. Forty eight universities from eighteen countries filled it out (see Table 1 for the list).

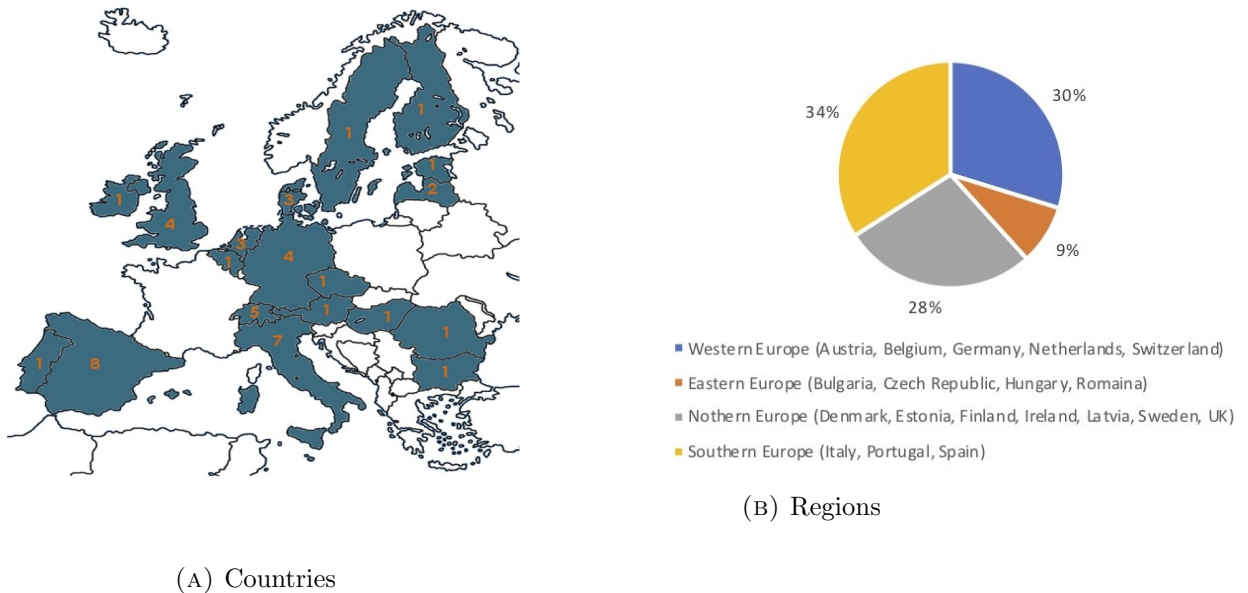


FIGURE 1. Location of Respondents

Our survey was wide ranging. We wanted to understand how universities valued interdisciplinary research, about teaching Informatics to non-specialist students, what happens in 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 Appendix A.

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

2. RESEARCH

Luis Caires

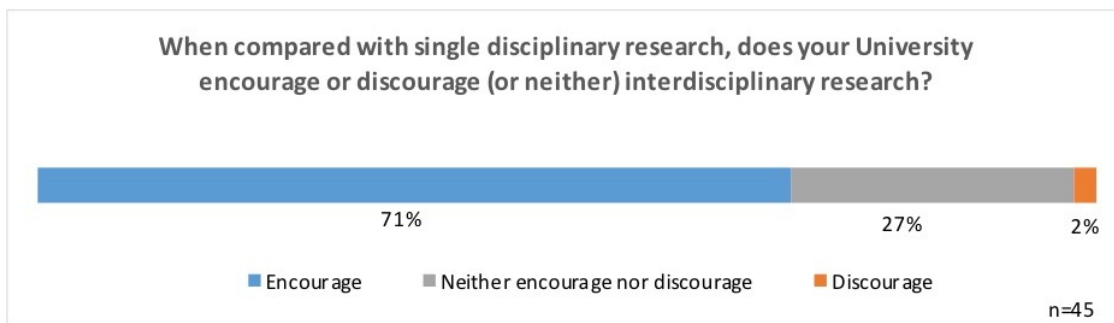


FIGURE 2. University attitude towards Interdisciplinary research

2.1. When compared with single disciplinary research, does your university encourage or discourage interdisciplinary research?

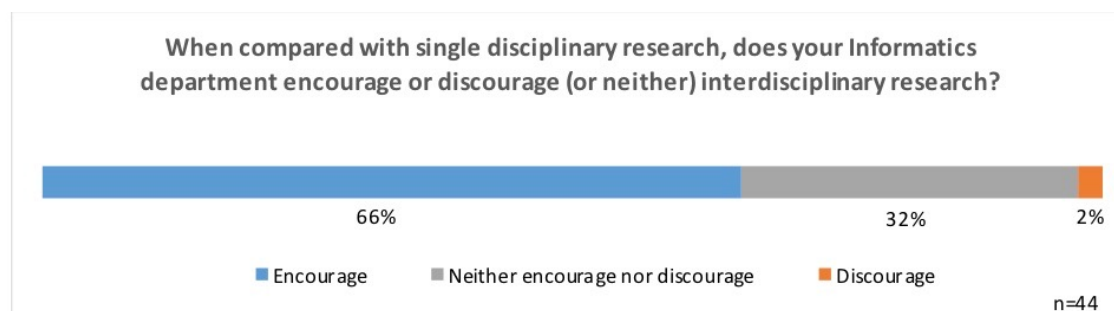


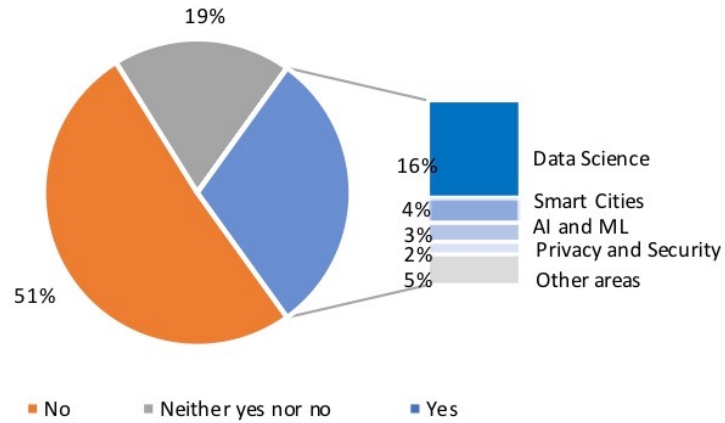
FIGURE 3. Department attitude towards Interdisciplinary research

2.2. Does your Informatics department encourage or discourage interdisciplinary research?

| | 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 University of Stuttgart |
| 8. | Hungary | Eötvös Loránd University |
| 9. | Ireland | Technological University Dublin |
| 10. | Italy | University of Bari Aldo Moro Università di Torino Alma Mater Studiorum - Università 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 Politècnica 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 – non IE members are marked with (*)

Are there interdisciplinary areas of research where your university could (should) enter but aren't due to lack of university support?



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

FIGURE 4. University support

2.3. Are there interdisciplinary areas of research where your university could enter but aren't due to lack of university support?

2.4. Are there other players who have helped increase the interdisciplinary research in your university?

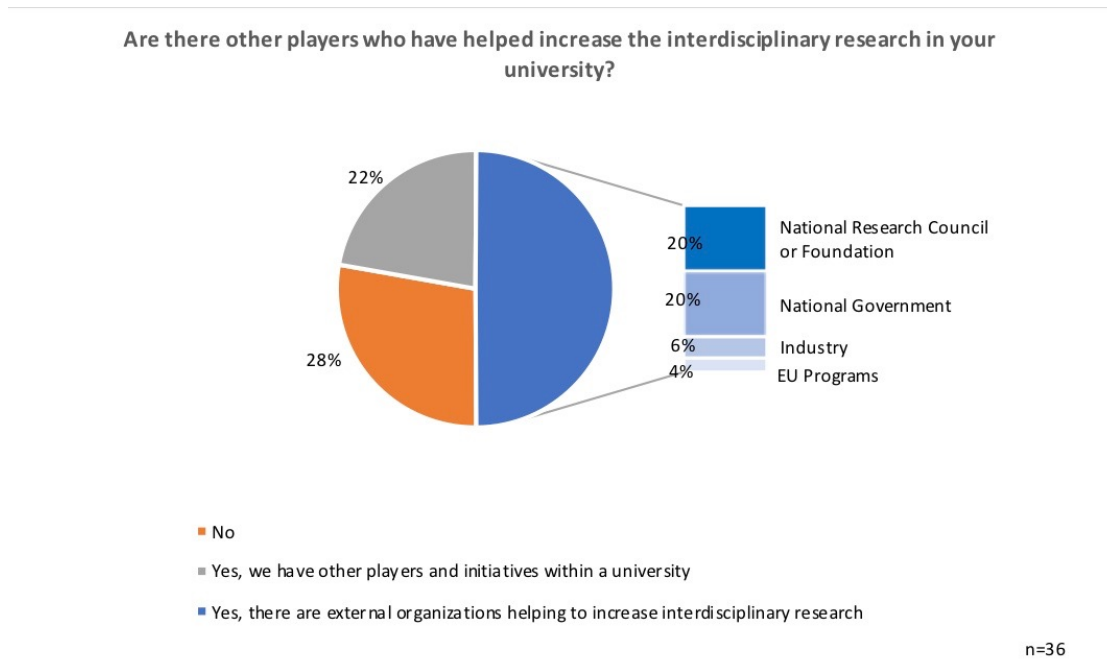


FIGURE 5. Other support

2.5. Please comment on any advantages or disadvantages you perceive of your university's arrangements.

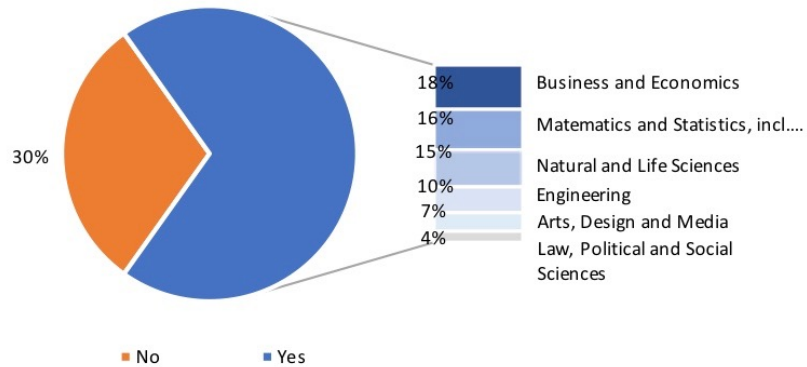
3. TEACHING

Inmaculada Garcia Fernandez

3.1. 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? 30% of the universities do not run a joint degree that includes Informatics (see Figure 6. Within this group of universities, some specified that all their programs entail technical aspects of IT, such as programming or data base technology. At some of these universities there are plans for some joint programmes, e.g. a Data Science BSc programme that joins CS, Maths and Industrial Engineering, and an MSc 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 or the Business School has their own small Informatics programme for the new degree.

The remaining 70% of the universities run 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

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?



n=46

FIGURE 6. Joint degrees

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 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 ?? summarizes the joint degrees (BSc. and MSc) offered by one or more universities and the countries where they are located.

3.2. 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 (see Figure 7). Most of the universities

| 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

not already offering joint degrees 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, University of Malaga, University of Southern Denmark, Humboldt-Universität zu Berlin, followed by the subject of Natural and Life Sciences (University of Bern, University of Stuttgart, University of Lugano, Humboldt-Universität zu Berlin and Law, social and political sciences (RWTH Aachen, Eötvös Loránd University, University of Edinburgh, University of Stuttgart, Paderborn University) and finally

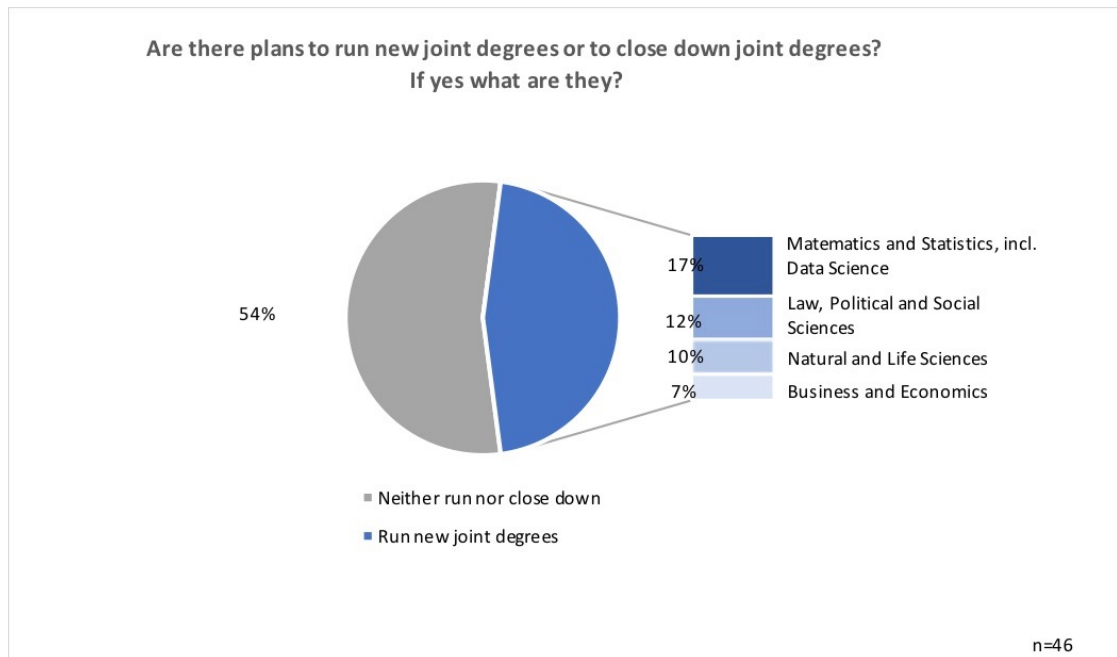


FIGURE 7. Plans for changes in joint degrees

the area of Business and Economics (University of Edinburgh, University of Bari Aldo Moro, Tilburg University).

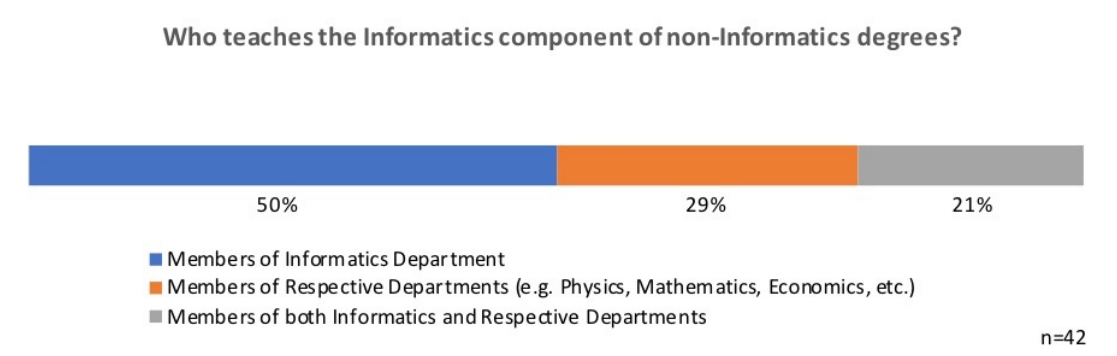


FIGURE 8. Teachers for external departments

3.3. 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 indicate that half of the universities (50%) give the responsibility of teaching informatics subjects to non-informatics degree students to members of the Informatics department (see Figure 8). In an additional 21% of the

universities, the responsibility of teaching Informatics is shared among the Informatics department and other departments involved in the joint degree; some of the universities specify that only the general/basic informatics subjects of non-Informatics degrees are taught by academics in the 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 responsibilities for non-Informatics degrees. A significative percentage of the universities 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.

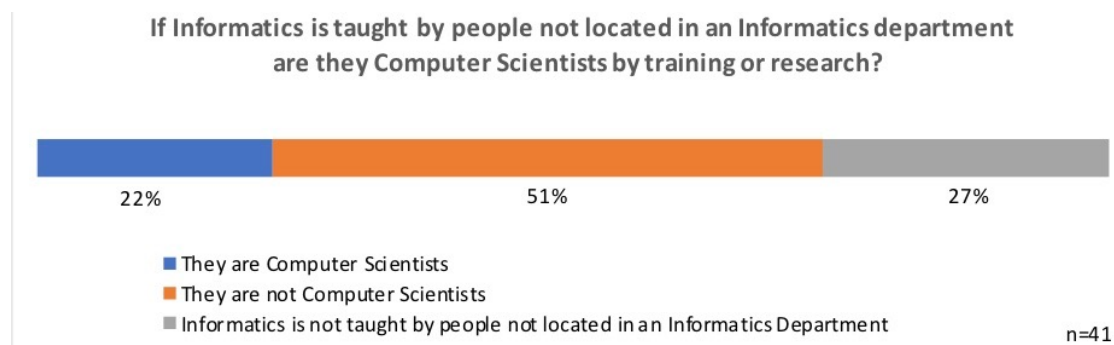


FIGURE 9. Teachers for external departments

3.4. If Informatics is taught by people not located in an Informatics department are they Computer Scientists by training or research? 27% of the respondents reported that all Informatics taught in their university was taught by members of the Informatics department (see Figure 9). Additionally, 22% of the answers specify that informatics is taught by Computer Scientists. Most of the universities participating in the survey recognize that some of the people who teach informatics for students of non-informatics degree do 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 in the Electrical Engineering Schools, Economics/Management people at the Business School, Physicists or Engineers in Robotics or Industrial Engineering degrees. Additionally, in some universities the basic informatics courses are taught by non Computer Scientists.

3.5. Please comment on any advantages or disadvantages you perceive of your university's arrangements. The range of the answers is really broad. For some universities there exists a clear discipline-responsibility (e.g. Paderborn University), but

in others there are no clear policy about which department teaches informatics in non-informatics programmes (e.g. RWTH Aachen); lack of human resources prevents the informatics departments from being 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)

4. 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.

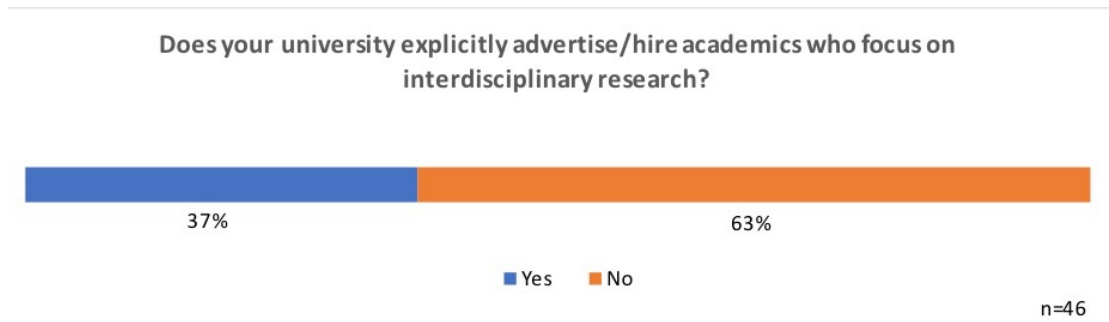


FIGURE 10. Interdisciplinary hirings

4.1. 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 10). 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.

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.

4.2. 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 11). 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.

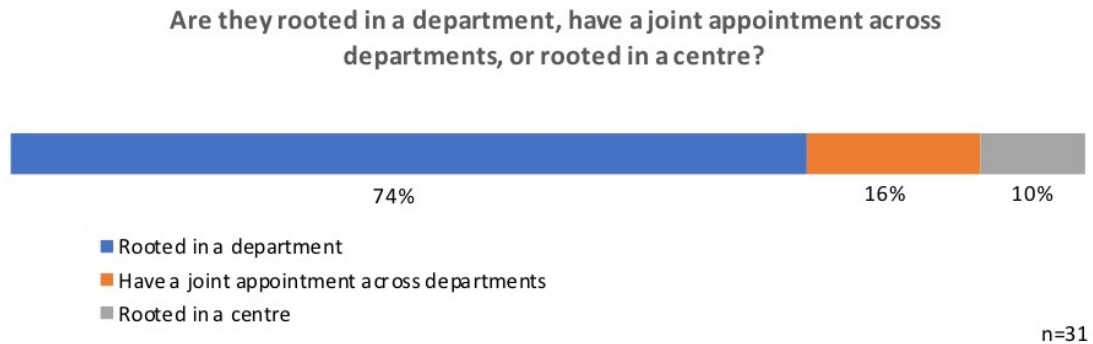


FIGURE 11. Affiliation of interdisciplinary faculties

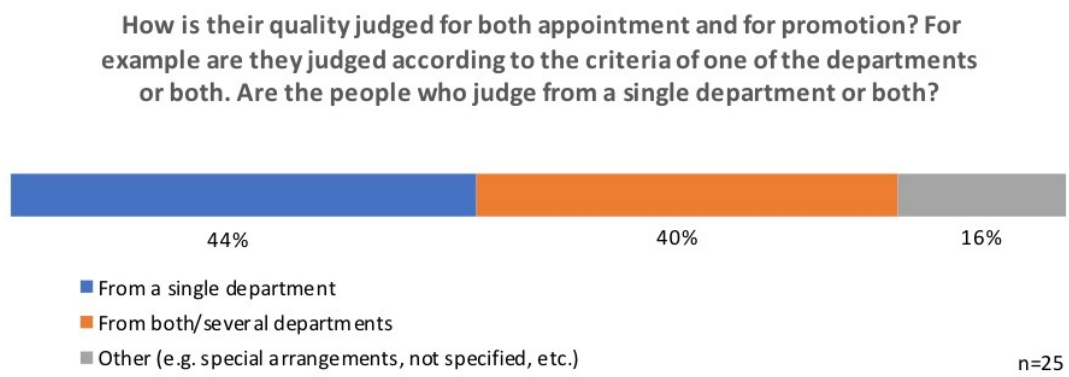


FIGURE 12. Assessment of interdisciplinary faculties

4.3. How is their quality judged for both appointment and for promotion?

As shown in Figure 12, 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.

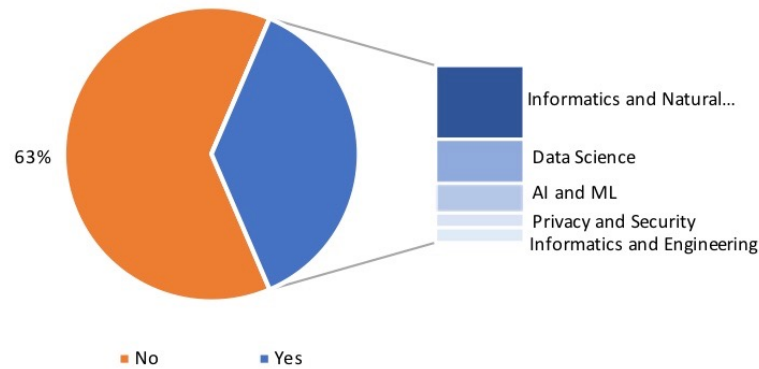
4.4. Are there any initiatives planned to hire in interdisciplinary areas?

As shown in Figure 13, the answer to this question appear to be quite similar to the ones discussed in Section 4.1. 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.

4.5. 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

Are there any initiatives planned to hire in interdisciplinary areas?



n=43

FIGURE 13. Planned initiatives concerning multidisciplinary hirings

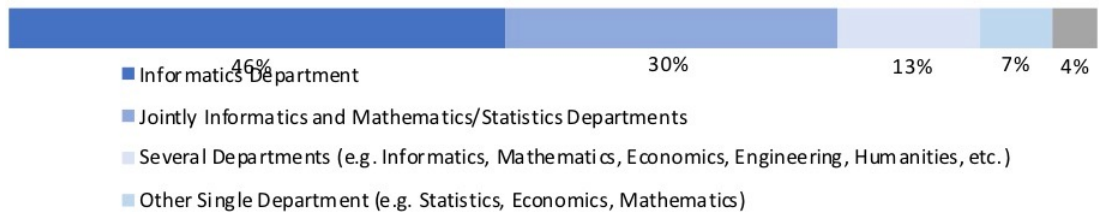
funding, often by third parties, dedicated to this. Even in this case, respondents highlight the difficulty of comparing researchers with different background and skills and the current lack of complete understanding of the phenomenon given the limited number of multidisciplinary researchers that are 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 multidisciplinary as an important aspect.

5. DATA SCIENCE

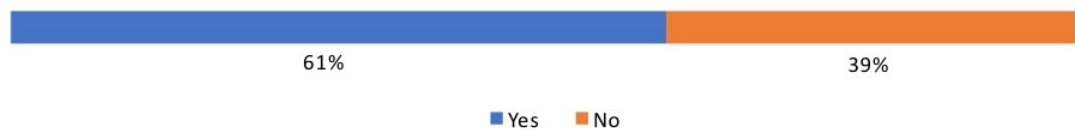
Eduard Groller

Which department in your university is seen to own the Data Science area?



n=46

Has the rise of the Data Science area changed the perception of Informatics overall in your university?



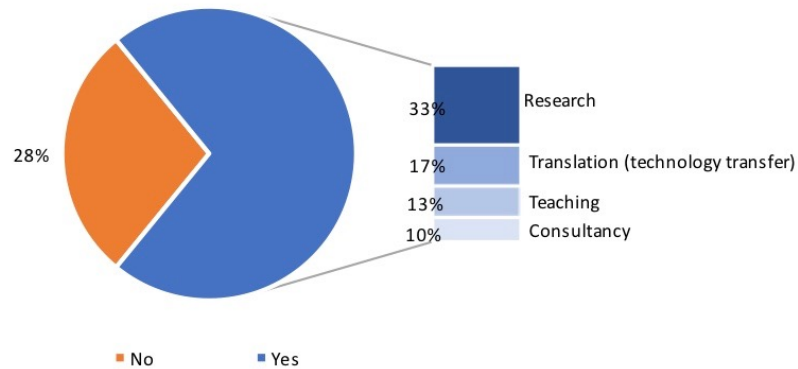
n=44

6. STRUCTURE

Luis Caires

Inmaculada Garcia Fernandez

Does your university set up centres for interdisciplinary work?
If yes, for what are these centres?



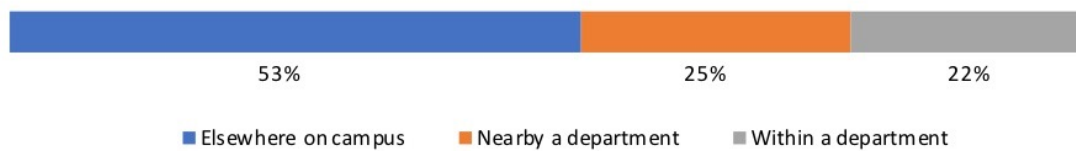
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Are they rooted in a single department, owned by the departments involved or independent?



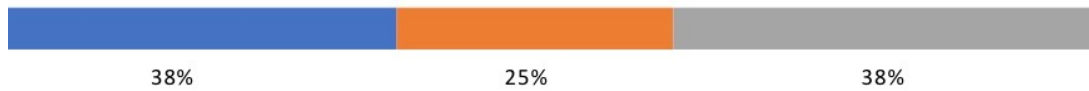
n=36

Are they rooted in a single department, owned by the departments involved or independent?



n=36

How are any centres funded? Does the university provide any money to startup or are they funded by external money?



■ 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?

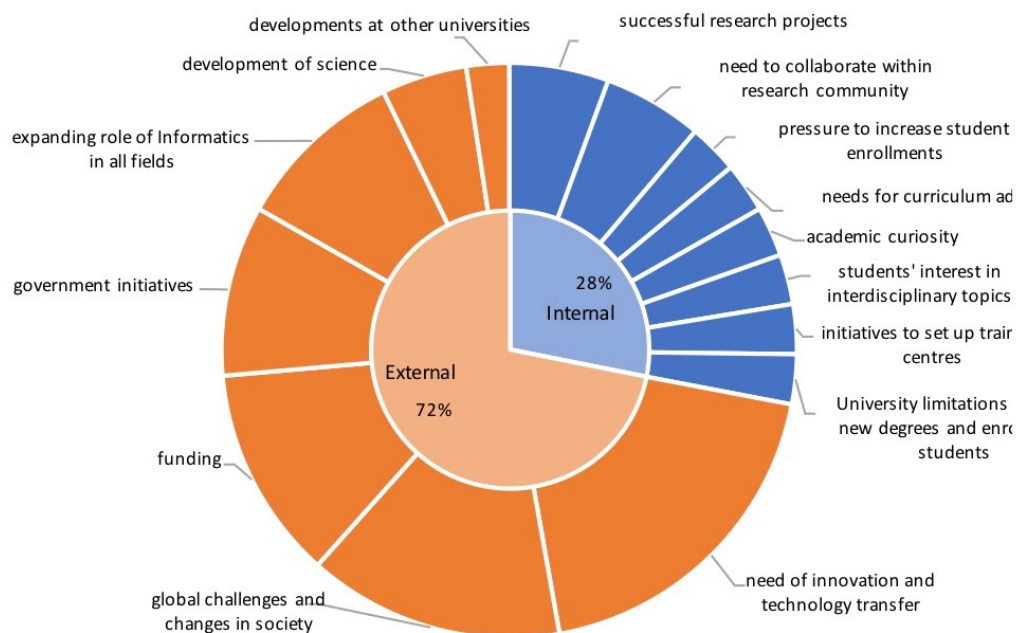


■ Set up more centres

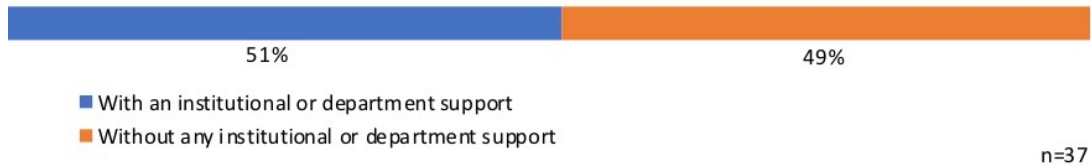
■ Neither set up nor close centres

n=41

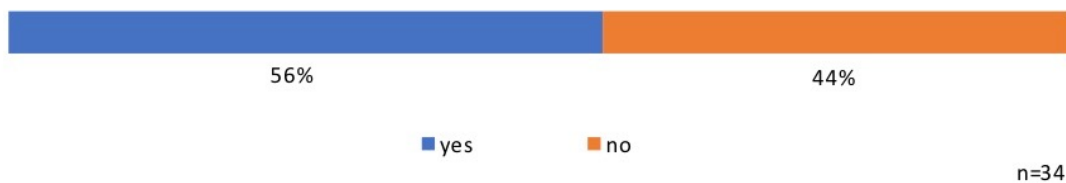
What are the drivers or pressures (both internal to the department /school/ faculty/ university and external to the university) that you see on the horizon that may lead to new activity?



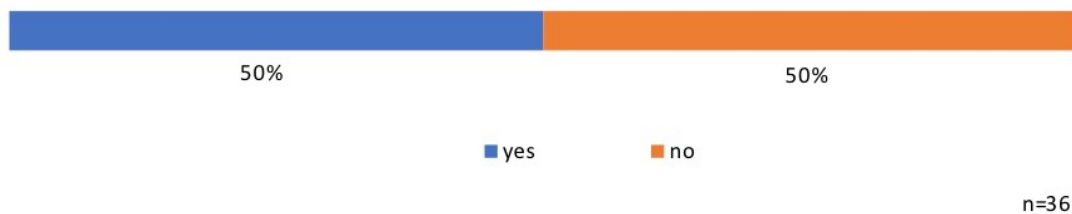
Is substantial interdisciplinary work undertaken by academics without any institutional or department support?



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?



Does your university have something in their official strategy to widen the role of Informatics or to encourage interdisciplinary research?



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/university 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?