How Big is Your IT Department?

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If you follow the recent IT-related discussions in South Africa with open ears, you will certainly have heard voices complaining about a shortage of skilled staff in the IT industry and a too low output of MSc-Graduates from South African universities on the one hand, as well as concerns about a too low level of research output in numbers of publications on the other hand. This phenomenon can easily be related to a discussion in which a "Crisis in Computer Science" (not to be confused with the notorious "Software Crisis") was diagnosed already 25 years ago by Peter Denning in his ACM President's Letter "Eating our Seed Corn" (Communications of the ACM, Vol.24, Iss.6, June 1981). This problem, still referred to as the "Seed Corn Problem" in the ACM Education Board Annual Report for the Fiscal Year of 1999 (http://www.acm.org/education/eboard/99report.html), will lead you directly to the crucial question: *How big is your Informatics department?* — or, if you are an industrialist rather than an academic: How big is your company's IT department?

For the sake of clarification I should mention that by "Informatics" I mean Computer Science and Computing Science in the widest sense. Being a continental-European Informatician myself I naturally use the term in its continental-European notion — French: *informatique*; German: *Informatik*; Dutch, Italian, Spanish: *informatica*— with its classically four subject categories of *Theoretical* Informatics (example: Automata Theory), *Practical* Informatics (example: Databases), *Technical* Informatics (example: Hardware Architecture), and *Applied* Informatics (example: Medical Image Processing). Needless to say that these four categories only serve the purpose of broad orientation —with many Informatics subjects standing firmly on two legs in two categories— and that Informatics itself has many fuzzy overlaps with a variety of sister-sciences such as Mathematics, Electro-Engineering, Physics, Linguistics, or even Philosophy. Moreover, the field of Applied Informatics has witnessed the creation of a variety of daughter-Informatics such as *Bio*-Informatics, *Medical* Informatics, *Business*-Informatics, and so on: the list is growing with the number of computer applications anywhere and everywhere.

For the sake of comparison, illustration, and inspiration let us now have a look at *Aachen* where I graduated as an Informatician in the second half of the 1990s. Aachen is a medium-sized town (about 200.000 citizens) in the very west of Germany — in fact the borders of Aachen's municipality touch the state borders of Belgium and the Netherlands at a frequently visited and much photographed *Drie-Landen-Punt*. What is now Aachen's main university, the RWTH, was established in the second half of the 19^{th} century as an institute of (basically) Geology, Coal-Mining, and Steel-Engineering. Only a few years later the existence of such new types of institutes also came in quite handy to the German emperor himself who needed all sorts of railway lines and steam locomotives, long-range cannons, steel-plated battle ships (etc.) for his various geo-strategic adventure games (the long-lasting effect of which basically boils down to nowadays existence of two semi-famous beer breweries: one in Windhoek/Namibia and another one in the Chinese city of Tsingtao). Anyway, those new institutions of technology —in contrast to the classical, humanities oriented universities— were able to provide the related technological knowledge and skills.[1] Today, the RWTH Aachen belongs to Europe's top technological and medical universities, with a student population oscillating around the number of 35.000 from generation to generation, (thus in the same order of magnitude as the student population of the University of Pretoria here in South-Africa).

As far as our *Informatics* topic is concerned, a quick scan of RWTH's websites (http://www.rwth-aachen.de/) yields the following snapshot (as of the second quarter of this year 2007): In the bullet-list below I have enumerated (to my best knowledge) all of RWTH's Informatics-related academic chairs (respectively research units), together with their numbers of professors and their numbers of scientific assistants. Most of these units belong to the Faculty of Mathematics, Informatics and Natural Sciences, some belong to the Faculty of Electronics, some belong to the Faculty of Mechanical Engineering, the Faculty of Economics, or even the Faculty of Medicine.

OK, those were the preliminary remarks — here are the actual data, to be read as: "Name of Academic Chair or Research Unit: Numbers of Professors: Numbers of Scientific Assistants":

- Numerics and Computer Mathematics: 1: *unknown*,
- Theoretical Information Technology: 1: 12,
- Computational Engineering Science: 2: 4,
- Algorithms and Complexity Theory: 1: 11,
- Theoretical Computer Science: 1: 6,

[1] The same was, by the way, true for England's Victorian "Red Brick Universities", in contrast to the ones of the Oxford-Cambridge category.

- Software Modeling and Verification: 2: 12,
- Programming Languages and Verification: 1: 3,
- Software Engineering: 1: 14,
- Software Construction: 1: 2,
- Communication and Distributed Systems: 1: 27,
- Distributed Systems: 1: 5,
- Design and Analysis of Secure Systems: 1: 3,
- Information Systems and Databases: 3: 18,
- Knowledge based Systems: 1: 5,
- Language Processing and Pattern Recognition: 1: 25,
- Logic and Discrete Systems: 2: 7,
- Mathematical Foundations of Informatics: 1: 4,
- Computer Graphics and Multi Media: 1: 7,
- Data Management and Exploration: 1: 6,
- Computer-Supported Learning: 1: 2,
- Media Informatics: 1: 10,
- Software for Embedded Systems: 1: 9,
- High Performance Computing: 1: 9,
- Software and Tools for Computational Engineering: 1: 4,
- Performance Analysis of Parallel Programs: 1: 5,
- Computer Aided Architectural Design: 1: 8,
- Informatics for Mechanical Engineering: 1: 6,
- Construction of Micro Systems: 1: 8,
- Computer Supported Analysis of Technical Systems: 1: 11,
- General Electrotechnics and Data-Processing: 1: 18,
- Operating Systems: 2: 5,
- Integrated Signal Processing: 3: 22,
- Communication Networks: 1: 28,
- Medical Information Technology: 1: 8,
- Digital Image Processing: 2: 11,
- Wireless Mobile Networks: 1: 10,
- Signal Technology and Data Processing: 1: 15,
- Signal Technology and Communication: 2: 11,
- Technical Informatics and Computing Science: 1: *unknown*,
- Medical Informatics and Biometrics: 1: 7,
- Business Informatics and Operations Research: 1: 6.

At other universities this could be regarded as an impressive list of lecture IDs or course modules — at the RWTH Aachen this is indeed the list of Teaching and Research Unites who are providing lectures in an even greater number and variety.

To avoid confusion in the international context I should also explain that by "professor" in the listing of above I mean tenure full professor or tenure associate professor (and in a small number of cases also: professor emeritus) — *not* "assistant professor" in the American terminology. By "assistant" I mean post-MSc or post-Doc researchers with salary and employment contract — *not* "research student" in the American terminology. Also note that usually (with a few exceptions) only the professors (and sometimes the doctors) act as *lecturers*, whereas the post-MSc assistants mainly organize student-tutorials or student-seminars, and also mark their professors' exam papers as they crop up: compare this situation to South-Africa, where a considerable number of lecturers are still working towards their MSc degrees.[2]

Summary of the web-browsing exercise: At the RWTH Aachen (which is comparable in student-numbers to the University of Pretoria) the entire field of Informatics (including closely related sciences) is almost completely covered[3] by about **50** professorships, supported and assisted by more than **350** in-house Post-MSc research employees (which makes an average of 7 full-time scientific assistants per professor).

The benefits and advantages of such an institutional richness are obvious:

- Almost every area of Informatics is personally represented by a renowned expert (professor),
- Every topic is lectured by a well-known specialist in that topic (thus: less need for "teaching by the book" through non-specialist "alround"-lecturers),
- Considerable academic freedom also for the students (with a large number of optional lectures, varying from year to year, to choose from), and last but not least
- A large number of wide-spectrum Informatics graduates being produced not only on BSc level but also on MSc level year by year.[4]

Finally we are coming back from our "internet journey", back to our local context: As the "foot soldiers" at the research and teaching front in South-Africa are being pushed by the "generals" towards higher and higher outputs (in numbers of publications and IT graduates) in these days, it seems only fair to ask the "generals" about their long-term strategy towards the equally needed *structural* and *institutional* growth, an example of which has been sketched in the listing of above.

And now you may ask the question again: How big is *your* IT department?

[2] Also note that those chair professors enjoy a certain degree of organizational independence: together they form a "subject group" that is represented by their "speaker"; however they are not subject to an executive head of department in the way we know it from the rather managerial British or South-African universities.

[3] Nota bene: the Latin root of the word "university" can be broadly translated to "all-comprehensiveness"

[4] although the scientific, respectively Engineering subjects are currently generally loosing popularity amongst German secondary school pupils and university "freshers", whilst at the same time large numbers of IT graduates, including myself, are currently "brain-draining" out of Germany into the Anglo-Saxon world for various reasons — one of which is the rather slow production of academics within that part of the world.