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University of the Future: A Fractal Organisation of Knowledge

1 Introduction

In their report *The Future of European Universities*, the authors Richard Lambert and Nick Butler ask in the title: *Renaissance or Decay?*[1] They see the following weaknesses of European universities:

1. The increasingly more visible exodus of young talented scholars fleeing Europe as a result of insufficient financing of universities;
2. An excessive number of universities pursuing exactly the same objectives – the majority of the 2,000 EU universities aspire to research activity, at the same time running both undergraduate and postgraduate courses, and expect to be financed, whereas in the USA only 215 out of the total of 3,300 qualification-awarding institutions offer the postgraduate level, and not even a hundred are recognised as research universities;
3. Their unprofessional management.

As Krzysztof Pawłowski writes, the share of Europeans among the Nobel Prize winners in the 20th century has been systematically decreasing, from almost 100% in the years 1900-1910 to about 70% in 1930-1940, 50% in 1960-1970, and 26% in 1990-2000.[2] These figures are self-evident. Changes in universities seem to be essential.[3]

The authors of this study are of the opinion that changes in the domestic higher-education system (i.e. at the university level) should be accompanied by changes within the universities themselves. In the situation whereby politicians are reluctant to introduce student fees, universities should aim at optimising the use of their existing resources – both financial and, more importantly, human. Therefore, the authors concentrate on pinpointing opportunities for improving the organisation of universities.

The aim of this study is to present a university model applying the concepts of the knowledge-based and fractal organisation. The first part is a brief description of the university as an organisation committed to knowledge. The second part – also referring to the future of universities – presents its fractal model of organisation. In the conclusion, the authors present the common points that both the fractal and knowledge-based organisations share.

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1 Lambert and Butler 2006, p. 3
2 Pawłowski 2004, p. 18
3 Clark 2005

2 Knowledge-Based University

Establishing a model of the knowledge-based university requires delineating the features that are conducive to creating and processing knowledge (its transfer and conversion) and that may lead to an improvement of these processes.[4] The model proposed here is based on the assumption that universities are examples of professional bureaucracies,[5] whose main characteristics include: a highly qualified staff, horizontal specialisation, decentralisation, relative independence (autonomy) of the staff, intellectual authority, as well as obligatory and universal professional self-development. These features promote creation and dissemination of knowledge.[6]

Christina Evans[7] formulates a set of characteristics typical of a knowledge-based organisation (Figure 1). Some of the features refer to public higher-education institutions.[8] The **ancillary leadership** is of special importance here because the key feature of any university is its strong leadership position serving the purposes of the academic community.[9] The role of the centre is co-ordinating the activity of each particular organisational unit of the university and, above all – a flexible approach to problem solving in order to guarantee its staff a degree of self-organisation so typical of knowledge-based organisations. It may be facilitated by the fact that self-organisation is founded on the following principles of holographic design that may be – according to the author – applied to designing knowledge-based universities:[10]

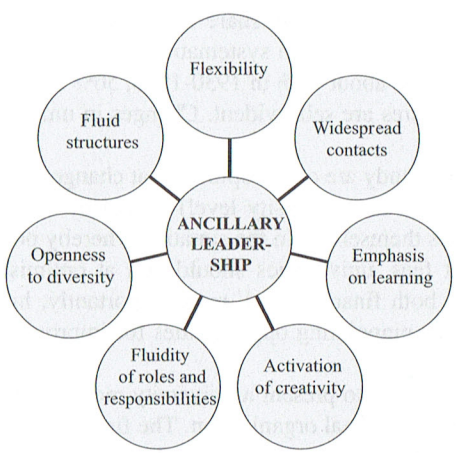

Figure 1: Model of a knowledge-based organisation, Source: Evans 2005, p. 58.

4 Nonaka and Takeuchi 1995
5 Mintzberg 1983, p. 189-213
6 Martin and Marion 2005, p. 142-143
7 Evans 2005, p. 58
8 Leja 2006, p. 17-22
9 Clark 1998, p. 5
10 Morgan 2005, p. 110-117

- *the principle of the redundancy of functions* – many universities enjoy a surplus of ability, which allows for its flexible design. This enables the development of new functions, e.g. connected with implementing new study programmes or carrying out joint research projects that require role shift,
- *the principle of necessary diversity* that illustrates how much of a whole must be built into a part, something that seems workable in the university – an institution abundant in diversity. Diversity proves sufficient (i.e. redundancy of functions – adequate) when the organisation is capable of reacting to external challenges. In the case of universities this means creating heterogeneous research or didactic teams representing the complexity of tasks to be tackled,[11]
- *the principle of the critical minimum of specification* – managers should be flexible enough to facilitate team self-organisation rather than organize teams themselves. It must also be assumed that roles may shift in university teams, depending on circumstances. This solution breaks away with the hierarchical pattern and bases the teams' activity on "deliberation, not a project assumed in advance,"[12]
- *the principle of learning how to learn* – the ability of a team to self-organize, self-regulate and self-control depends on its ability to learn and use learning as feedback for further learning. This facilitates solving more and more complex problems faced by research and didactic units.

Flexibility of universities, just like any other modern organisation, is measurable in their response both to turbulent environments[13] and the influence of internal stimuli.[14] The new Polish legislation on higher education (of 27 July 2005) favours this flexibility, both in terms of university teaching (e.g. interdisciplinary courses, macro-courses) and research (e.g. incubators of enterprise, technology transfer centres as university units or partnerships/foundations).[15]

In universities, due to the significance of collective and advisory bodies, the dominant form of flexibility is adaptive-inertial (i.e. the response to external expectations is not instantaneous).[16] In the knowledge-based university model, what should be targeted is rather the anticipatory flexibility type (i.e. responses are prepared ahead of time, just like the moves in the game of chess, and awaiting internal or external triggers, like the opponent's move).[17]

Activation of creativity is an important task for any university that is an organisation of knowledge, not just a black box where the entry and exit data are

11 Ibidem, p. 114
12 Ibidem, p. 115
13 Jasiński 2005, p. 15-20
14 Krupski 2005, p. 22; Clark 2005, p. 71-95
15 Prawo 2005
16 Krupski 2005, p. 24
17 Ibidem

the only important parameters reaching the financing bodies.[18] Staff creativity, understood as "reaching pertinent innovative ideas, individually or in small groups"[19] is reinforced by the flexibility of organisational structures and flexibility of managing human resources. Factors of human creativity include: competence, attitude and motivation to work.[20]

Fluid structures – Universities are exceptionally complex organisational structures, and academic communities tend to be very diversified. According to Morgan, the structures should represent the idea of the university, not just reflect its habits and traditions. The image of an organisation as a brain, presented by Morgan, is especially intriguing when extended to universities. It shows knowledge imprinted in every organisation, and each of its parts (just like each cell of the human brain) represents it as a whole.[21]

Emphasis on learning – Advocating learning in teams is a key factor in acquiring knowledge, creating the atmosphere of group openness and observing the principle that "adverse events and negative findings may serve as a source of great practical value."[22] The quality of learning also depends on respecting various points of view in discussions, irrespective of the academic position of their proponents. Questioning established solutions and "canonical" opinions, as well as undermining standards, are also qualities of the "double loop" learning.

Widespread contacts – Knowledge is universal, so sharing new and existing knowledge should not be hindered by geographic or language barriers. Domestic and international contacts promote knowledge dissemination. Both private and institutional relationships create opportunities for the transfer of knowledge that in turn leads to the creation of new knowledge. This is also conducive to a faster shift from the linear to the more interactive process of generating knowledge.[23]

Fluidity of roles and responsibilities – University staff should aim at creatively pursuing the truth rather than merely conducting their everyday duties. For this reason, it is pointless to delineate the range of responsibilities for a knowledge-committed academic. Fluid structures and organisational flexibility may allow that the pursuits of truth. Peter Drucker writes: "Individuals must be able to work simultaneously in various organisational structures. (...) The same person who is a 'boss' in his/her organisation may be a 'partner' in an association, a minority shareholder or a participant in a joint enterprise etc."[24]

Openness to diversity – Appreciating diversity is a feature of all knowledge-based organisations, particularly universities. Variety is a source of creativity; therefore teams composed of specialists in various fields may be more innovative.

18 Kwiatkowski 2001, p. 231
19 Evans 2005, p. 61 quoted Amabile 2001
20 Ibidem
21 Morgan 2005, p. 89
22 Morgan 2005, p. 102
23 Wawrzyniak 2004, p. 278
24 Drucker 2002, p. 120

Forming groups of people who share similar views, knowledge or skills does not lead to creativity. Diversity must be reinforced by an atmosphere that promotes an unrestrained transfer of thought. An interesting example of the significance of diversity in business is the opinion of one CEO, who claimed that he preferred to employ someone with a Ph.D. in Russian literature than an MBA graduate because "the knowledge of Dostoyevski stimulates curiosity and the learning drive" – key features in an enterprise that aspires to the name of a learning organisation.[25] We may venture the statement that university teams consisting of members from different fields and with different interests are more creative than "homogeneous" teams.

3 University as a Fractal Organisation[26]

The foundations and definition of a fractal organisation were formulated by H.-J. Warnecke.[27] He stressed the integrative aspect, emphasizing the multi-dimensional nature of the issue. The concept distinguishes between two main organisational "layers": the macrofractal, i.e. the whole organisation, and the microfractals, i.e. the smaller units constituting the fractal organisation.[28] We shall therefore consider the whole university as a macrofractal, and units such as faculties, departments, institutes and divisions, as well as formal and informal research and didactic teams, as microfractals. The teams may be of various sizes (usually between 3 and 9 members, sometimes even a dozen or so) and may be set up around particular projects, programmes or undertakings.

On the basis of professional literature, we may define a "fractal university" as one that:

- functions on the basis of self-organised, autonomous groups (research or didactic teams) composed of university staff, students and "external" members, typically business practitioners, local authorities or any other people actively involved in the activity of the microfractal;
- forms an organisational structure whereby mechanisms of "inheriting aims" are its integral element, which is connected with methods and techniques for improving the organisation's work based on the principles of "good practice";
- allows continuous change of organisational structures as a result of implementing the principle of self-optimisation of work resources and processes, which leads to a high level of adaptability in changeable market (educational) conditions; this, in turn, influences the creation of added value for the client;[29]

25 Andrews, D'Andrea, Tyson 2005, p. 26
26 See also: Ihsen et al. 1998, p. 13-22
27 Warnecke 1995
28 Warnecke 1995, Mandelbrot 1997
29 Clients understood as current and potential students of all the forms of courses, as well as enterprises utilizing the findings of research carried out by universities.

- achieves a high level of vitality as a result of using flexible forms of work and guaranteeing a high level of freedom, which enables fast responses to changes that take place both outside and inside the university;
- offers full accessibility to managerial means and methods known in the organisation, which permits the optimal use of the university's resources;
- enables all fractal units of the university to navigate towards a common, set direction through permanent controlling and steering activities;[30]
- on the basis of full access to information and its unobstructed, dynamic flow, positively influences learning processes, self-development and improving its members' qualifications;
- best functions in a turbulent environment characterised by fast dynamics of change, which is, for example, typical of the present-day EU education market;
- requires from its members good communication skills, fast learning abilities, willingness to share knowledge and information, as well as high mobility and flexibility in planning and implementing work processes;
- obliges its members to apply holistic care and show responsibility for the work processes carried out for the benefit of the client.

This definition covers only the most essential aspects of the concept. From the methodological viewpoint, however, it is important that we present the issue in a more systematic manner. For this reason, it must be pointed out that fractal organisations display certain **main (basic) characteristics**, including: **self-organisation, self-sameness, vitality and dynamics, self-optimisation and navigation**; as well as **complementary characteristics**, such as: **setting goals by means of substantiation and negotiation, unobstructed information flow, creativity and openness to innovation**.

To further develop the concept of fractal organisations and to convert it into a set of standards that universities might follow in the future, let us consider the main characteristics in more detail (Tab. 1)

Table 1: Main characteristics of the fractal university model

Self-organisation
Autonomy of didactic and research fractals (a large degree of freedom in activities – mainly in selecting methods, techniques and decision-making).
Independence in acquiring resources.
Initiating change "from inside" in order to react immediately to changes in the scientific and research environment.
Introduction of self-regulatory rules (work sharing within the group).
Within the group, introduction of: • rotating organisational roles in staff teams (microfractals). • student involvement in the process of offering services.

30 We do not, however, refer here to introducing processes of full, ongoing control, but rather managing teams in a way that assures consistent alignment of their aims with the aims of the university.

Self-sameness
Isomorphism of the parts and the whole, based on the assumption that any newly emerging didactic or research structure reflects the superior structure.
Multiplication ability of didactic and research teams.
Identity of goals, tasks and functions resulting from the mechanism of "inheriting aims".
Globalisation of local action strategies, i.e. transferring the strategies to the general strategy of the university.
Close connection with the information system necessary in maintaining maximum similarity to the organisational structure of the university.
Vitality
Using the principles of ordering parameters, which control the overall behaviour of all individual and independent didactic, research and consulting bodies (microfractals).
Particular microfractals offering mutual services (creating a friendly co-operative climate inside and outside the university).
Atrophy of fractal groups in times of inactivity (dormant state).
Permanent emphasis on self-renewal.
Avoidance of disruption (especially with regard to internal organisation).
Dynamics
Synchronisation and parallelism of processes – simultaneity of actions, i.e. possibility to carry out numerous didactic, research and/or consulting processes at the same time.
Adaptability to new external conditions.
Proper anticipation of change in the educational environment of the university.
Responsibility of microfractals (didactic and research teams) to consolidate forces within the organisation.
Communication on the levels above units that are superior fractals, i.e. faculties, institutes, departments etc.
Self-optimisation
Basing didactic and research work on "rationalisation rounds" (supra-hierarchic and supra-fractal discussion groups, integrative workshops, moderation and training (coaching, mentoring).
Forming an overall client-firm structure, i.e. student- (or private/state company-) university.
Maintaining an appropriate level of redundancy of resources (especially intangible) at the university.
Stressing the necessity for decentralising university power.
Carrying out optimisation work in three basic stages: anchoring the project, system design, preparing the organisation.
Navigation
Constant checking, reporting and possible adjustments to the respective positions of particular microfractals (didactic, research and consulting) in the context of the university's objectives.
Creating decision-making freedom of choice of the navigation tunnel, i.e. the space for decisions, behaviours, actions and control of organisational and managerial events in particular teams.
Using navigation maps (spatial and relationship) of the university.
Creating added value for the students and units interested in co-operating with the university,
Instilling a sense of necessity for constant self-control among the university staff.

Source: own, based on Binsztok 2005, p. 141-142

As mentioned above, the functioning of a fractal university should be mainly associated with the activity of autonomous research teams (microfractals). In the general sense, their work may be compared to the principles that govern the actions of teams in modern-day organisations. A. K. Koźmiński discusses the issue extensively.[31] He points out, quoting D. Hertog and T. Tolner, that teams are "knots" in networks of loose and changeable structures that replace bureaucratic mechanisms of management and control in organisations due to the fact that they communicate and co-operate with each other.[32] Internal mechanisms of teamwork are therefore free of formality and routine, which is especially visible in the fractal concept discussed here. Koźmiński concludes, on the basis of his own research as well as that of K. Obłój, D. O. Cushman, A. K. Koźmiński,[33] and F. D. Barett,[34] that elements binding and regulating the activities of such teams are:[35]

- common goals and common interests that are collectively set, identified and accepted as the direction to follow,
- integration and harmonisation of the means and resources that all members of the didactic/research team have access to, aimed at achieving the shared goal and mutual interests,
- common values and norms shared by the members of microfractals.

Clearly, one result of the above-mentioned factors should be collaboration based on trust and mutual respect.[36] This (perhaps idealised) picture is more and more often characteristic of market leaders, which shows how important the issue has become.[37] The authors consider it a crucial point in the debate on the future development of Polish universities.

Apart from the characteristics of contemporary teams, it is also important to identify their structure and functions. According to A. K. Koźmiński, we may distinguish several main types of teams:[38]

- management teams of higher and medium levels, which in the case of universities refers to their authorities as well as heads of institutes and departments,
- cross-functional teams – staff groups from various faculties, departments and divisions, as well as formal and informal teams composed of university staff from the institution in question and those from other universities (teachers and researchers),
- support teams, i.e. university administrative staff,
- autonomous work teams[39] working on particular research projects.

31 Koźmiński 2004, p. 141-160
32 Hertog and Tolner 1996, p. 1706-1707 quoted by Koźmiński 2004, p. 147
33 Obłój, Cushman, Koźmiński 1995, p. 54 quoted by Koźmiński 2004, p. 145
34 Barett 1987, p. 24 quoted by Koźmiński 2004, p. 147
35 Koźmiński 2004, p. 147
36 See also: Koźmiński 2004, p. 147; Hansen and von Oetinger 2001
37 More about the question of trust later on in the text.
38 Koźmiński 2004, p. 148
39 See also: Koźmiński 2004, p. 148; Raynor and Bower 2001

However, in the case of future universities as fractal organisations, the difference is that all teams (microfractals) should by definition display many (or all) of the above-mentioned functions because:

- even though they report to the management (university authorities), microfractals are in fact highly autonomous, their freedom of decision-making and responsibility being extensive;
- thanks to the transparent and rapid information flow, especially the effective mechanisms of sharing knowledge, and as a result of copying good solutions (mainly organisational and managerial) that other teams came up with in the past, fractals automatically modify their structures. In this way, by using other fractals' concepts of innovation and work efficiency, they form selfsame organisational structures that reflect all the functions of the university;[40]
- taking advantage of the principle of complementary mutual service, fractals spontaneously support each other through high mobility of human, capital and material resources.

Co-operation based on such principles leads to simplifying the organisational structure and creating selfsame, self-organizing teams. This structural model of university organisation facilitates to a large extent the functioning of the organisation and – as Torres and Spiegel put it – unifies the principles of each self-managed team's work. It has a positive impact on the organisation itself, resulting in:

- better work flow,
- lower staff turnover,
- higher flexibility of staff,
- improved quality of products and services,
- reduction in executive personnel,
- more thorough staff appraisal,
- objective setting of salary ranges,
- group acceptance of appointed advancement candidates,
- introducing fair, objective and justifiable systems that comply with the principles of fair employment and affirmative action,
- easy formulation of drawbacks in training, education and skills.[41]

In the case of the above-mentioned self-managed teams, another factor that plays a significant role is the commitment of its members, as outlined in Table 2:

40 Excluding some decentralised activities in the domain of finance, personnel, legislation etc.
41 Torres and Spiegel 2000, p. 18-19; see also: Bullinger, Ilg 2003

Table 2: Commitment of traditional university staff and self-managed fractal teams

ANALYSED ISSUE	TRADITIONAL TEAMS	FRACTAL TEAMS
ROLES:	Set	Changeable
TASKS:	Strictly delineated	Flexible; often modified in the course of completion
SKILLS:	Specialised	Miscellaneous Wide spectrum of general knowledge
CONTROL:	Individual	Collective + self-control
STATUS:	Various	Equal
SUPERVISION:	External	Within the group, minimum control from authorities
WORK EFFORT:	Distributed	Shared; if possible – evenly divided amongst all team members
LEADERSHIP:	Usually one person	Divided amongst team members

Source: own, based on: Torres and Spiegel 2000, p. 14

The concept of fractal universities based on knowledge may prove interesting in the future, bringing measurable benefits to both the universities (as seen holistically) and their clients (i.e. students).[42]

4 Conclusion

The list of characteristics of the knowledge-based university and the fractal university presented here is far from exhaustive. However, indications clearly point to a certain convergence of these two concepts. This is perhaps most visible in the example with a description of self-organised fractals. It would be no easy task to introduce such characteristics in practice, mainly due to the fact that universities are so attached to tradition. The intention of the authors was to emphasize the need for change in the realm of higher education, as evidenced by the following current trends:

- a growing need for team autonomy and organisational flexibility,
- an increased rate and capacity of information channels ensuring unobstructed flow of information and knowledge,
- a strong drive to share knowledge,
- the promotion of creative attitudes among members of organisations,
- a focus on innovation.

Fractal organisation of the university seems to be more efficient than the traditional style of organisation because it favours the creation and diffusion of knowledge.[43]

42 See also: Capponi et al. 2001
43 Perechuda 2005, p. 59

The authors see the proposed model solutions for universities of the future as advisable, while bearing in mind the fact that introducing such changes would require very careful preparation. It would also be necessary to persuade the academic community that there are well-grounded reasons behind the difficult task of systemically implementing the changes.

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