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"Scientification of Work" as a Challenge to University Education

1. The Criticism of the Neoliberal University Model

One of the most influential German critics of today's organisation of the universities, Richard Münch (2011, p. 64), poses the intriguing question as to how the process of the colonization of science by the economy can take place on a global scale even though the counter-productive effects of such development are undeniable. Münch's analysis of the universities' development diagnoses a fundamental shift from past to present, a "transformation of the university that provokes questions about the deeper meaning and mission of the 'university in our time'" (2014, Introduction). Traditionally, "professional trusteeship" would be "at the core of the provision of services by the university in the sense it has assumed in Wilhelm von Humboldt's tradition" (ibid.). The collective epistemic process – "basic research, applied research, education for the professions, and education of citizens" – would be taken care of on a trust basis by scientific communities in universities. Recognition and reputation (as the most desired goods) would serve as a means for competition. "The trustee provides services in the best interest of the trustors according to the best of his knowledge and belief. The societal community is the primary trustor, and the secondary trustors are the students, industry, government and administration" (ibid.). However, due to the New Public Management as "part of the world-wide diffusion of science as the great promoting force of societal progress" and as a strategy for a "science-based rationalization of public administration" (ibid.), the university would have been transformed "into an enterprise", and "transforming the trustee into a supplier of services blurs the boundaries between science and the economy, at the cost of science as something worth doing for itself". Paradoxically, the New Public Management would consider the market as an advantage as its reforms would "count on competition to improve services and to attain a similarly optimal allocation of supply and demand as in market competition" even though "there is no real market and no price mechanism" for services of the public sector (ibid.). Münch thus agrees with Mathias Binswanger

(2010, pp. 44–66) who "identified three illusions of this new paradigm of competition without real markets: (1) the illusion of the market itself, (2) the illusion of measurability, and (3) the illusion of motivation" (ibid.). Münch diagnoses "dangerous consequences for the openness and dynamics of knowledge evolution" as the "turn of governing performance exerts particularly fatal effects, where variety and creativity are most important, such as in the furthering of progress in scientific knowledge". "Without sufficient variety and competition the evolution of knowledge is in danger of being narrowed down to beaten paths" (ibid.). A fatal paradox, indeed!

Although Münch's analysis undeniably delivers a thought-provoking argument, we would like to raise a different awareness of problems regarding the relationship between science and economy. The main point of our critique against Münch's argument concerns his notion of science and economy stylized as some self-reliant, self-referential systems that would have functioned in former times each independently from each other. Münch moreover argues that only the recent change would have led to a loss of independence for the academia as this field has become dominated by the rules of a simulated market and surrendered to central agencies that exert power by means of e.g. funding, rating, and certifying. With regard to the New Public Management, Münch's arguments are quite convincing that an entrepreneurial way of thinking brings about paradoxes and counter-productive effects to scientific progress. Nonetheless, we would like to explore and reanalyse the relationship between science and economy in a slightly different way by acknowledging the contradictions and paradoxes not only as an outcome of a new management strategy but also as essential features of the larger societal process in which the transformation of the university is only one part. This reanalysis takes into account that scientific progress is not immediately part and parcel of the societal process. Scientific knowledge is not directly a driving force for modernisation and rationalisation. It is important to recognize in what ways it is developed as a specific professional knowledge in a certain domain and in what ways it is interlinked to the knowledge in adjacent domains and professional practices.

2. Reanalysing the Relationship Between Science and Economy

It is thus also important to reanalyse the relationship between science and economy against the different backgrounds of the current socio-technological change, a change that is mainly driven by 'high-tech', which both requires and enables epistemic practices (a change described as "epistemization" or

"epistemification"[1]; Knorr Cetina/Preda 2001; Knorr Cetina 2007). The technological facilities of computerising, collecting, and scrutinising large amounts of data stimulate these epistemic practices as well as political ideas maintaining that a modern state and its societal forms of regulation need modernisation on the basis of processing and evaluating more and more data. This process is not simply an increase in or an expansion of economic power but rather in itself a contradictory societal process which is not sufficiently understood by looking at the economy as a power in itself or as a self-reliant system that simply imposes its rules onto other societal systems.

In our eyes, *the crisis of today's university is therefore part of a bigger societal crisis*, a crisis of all cultural forms of developing labour, production, circulation, and political regulation. To give some examples of the obvious problems faced by today's economies and societies:

1. Given the automated processing of Big Data[2], computer programmes nowadays independently analyse large amounts of business data and, as in New York, the totally automated stock exchange referred to as "BATS Y" (which entails a good allusion to the opaqueness of trading) decides independently which transactions to make and processes these transactions within less than 250 micro seconds. This means that the speculative side of each transaction, of buying and selling, is ultimately translated into a number of statistics and algorithms. Given automated stock exchange, economic advantages of trading depend on the speed of transactions made. This technological development has already resulted in a small elite excluding the majority of brokers and clients who do not have access to high-frequency trading. As revealed by Michael Lewis, "the U.S. stock market now trades inside black boxes, in heavily guarded buildings in New Jersey and Chicago" (Lewis 2014, p. 3). Consequently, human reflection and participation are absolutely meaningless within the trading processes themselves. A political debate on responsibilities, as for example after the crash of a stock market or after the selling out of a 'misbehaving' currency, would therefore need no longer scrutinize the traders' ethics but those of programmers, mathematicians, and their employing enterprises or banks in terms of a socio-technological concentration of power. The

1 In what follows, we will use the technical term "scientification".

2 Big Data is a technical term that designates huge amounts of digital data that are nowadays produced either by a large number of users (for example, when they search for information on the Internet and the search engine software keeps track of their clicks) or by digital devices and algorithms that are used to computerize complex analyses of statistics (e.g. to predict consumer behaviour) or patterns (e.g. of DNA sequences).

current situation is therefore quite ambiguous: On the one hand, programmers and mathematicians contribute to the "scientification" of stock exchange practices by which algorithms today are also able to take care of fixing or balancing a crash within a short time. On the other, the current lack of reflection and of political and economic participation within an automated stock exchange implies that the concentration of power in financial-market technologies and the related business loses its societal democratic legitimacy.

2. The second example of the societal crisis is the recently uncovered scandal, the spying out based on large amounts of globally transmitted digital data undertaken on a large scale by the NSA, the U.S. secret service. Claudia Eckert, head of Fraunhofer AISEC (Fraunhofer Institute for Applied and Integrated Security), stresses that "the confidence in ICT systems is seriously damaged" (FAZ 21.11.2013). She argues:
   "Since many business sectors and their clients depend however very strongly on reliable and trustworthy ICT, a Digital Europe must create the general context and provide alternatives to reduce the dependence [on ICT systems from US companies, I.L.] systematically by restoring the confidence with alternative and tested ICT solutions and by enabling a stronger digital sovereignty. […] Key business sectors beyond the ICT industry are the automobile and the supplier industry, the largely medium-sized mechanical and plant engineering segment, the energy and the health care sector. These business sectors need trustworthy ICT products, minimum standards for the quality of these products and reliable agreements on the political level." (Ibid.)
   The NSA scandal thus made it obvious that 'high-tech' such as ICT has become an essential infrastructure of business and that, similarly to analogue infrastructure, there is a struggle for influence and access to it. However, with regard to the development of ICT systems, the control over this infrastructure is hardly socialised and politicised. There is no institution within the current scientific-technological development which is independent, neutral, non-profit, dedicated to the public, and which is therefore trustworthy to manage to create ICT solutions without a "false bottom". This instance is both important to economic practices and civil society.
3. Last but not least, the quintessence formulated by the software architects Jack Greenfield and Keith Short (2003) on the challenges of a computerised economy is:
   "Over the last ten years, the software industry has met the demands of an increasingly automated society by honing the skills of individual developers, just as artisans met the demands of an increasingly industrialized society in the early stages of the industrial revolution by honing the skills of

> individual craftsmen. Up to a point, this is an effective way to meet demand. Beyond that point, however, the means of production are quickly overwhelmed, since the capacity of an industry based on craftsmanship is limited by its methods and tools, and the by size of the skilled labour pool. A quick look at the state of software projects suggests that we are already struggling to meet demand using the current means of production."
> The authors continue with balances of failures:
> "According to the Standish Group, businesses in the United States spend more than $250 billion annually on software development, with the cost of the average project ranging from $430,000 to $2,300,000, depending on the company size. Only 16% of these projects are completed on schedule and on budget. Another 31% are cancelled, primarily due to quality problems, creating losses of about $81 billion annually. Another 53% cost more than planned, exceeding their budgets by an average of 189%, creating losses of about $59 billion annually. Projects that reach completion deliver an average of only 42% of the originally planned features."
> What is captured in these balances is the insight that the required know-how or 'knowing' in the most advanced technological sectors must no longer be seen as a challenge that addresses individual qualification ("skills of individual craftsmen") only. It is acknowledged that demands need to be met on a cooperative level, at the level where different professional domains intersect and interact. In other words: Intellectualized labour such as IT work cannot come to perfection, cannot reach professionalism if we fail to recognize it as cooperative competence. Scientific ways of thinking play an important role here. This is what we refer to as "scientification of work" (Langemeyer 2012; 2014; 2015).

To sum up, the broader societal crisis that can be perceived in the problems outlined consists in the need for:

1. technological automation (including automated decision making as observable at the stock markets) to gain societal democratic legitimacy through defining responsibilities and enabling forms of societal participation,
2. trustworthy ICT systems or infrastructures that economic parties as well as the civil society can rely on, and
3. an educational institution that is apt and powerful enough to create the cooperative competences for the "scientification of work".

All these problems can be interpreted as being arguments for strengthening and upgrading the institution of the university in the 21st century. However, if the university is to play a major role within a democratic and trustworthy

socio-technological development, not only its management but also the ambivalent relationship between the academisation and scientification of work need to be investigated.

3. The Relationship Between "Academisation" and "Scientification" of Work

If the university develops as an institution meeting the challenges outlined above, the situation of today's universities in relation to the changing labour market and to changing forms of professionalism should be reflected. Several German publications recently have been dealing with the tendency of academising work but have not been making an analytical distinction to the "scientification of work".

The "scientification of work", as mentioned before, designates an intellectualised mode of working due to a reality that is "purposefully assembled and unfolded by professional knowledge workers and whole technological systems which provide the frames of reference and the means for experience and transactions to take place" (Knorr Cetina/Preda 2001, p. 30). While it seems obvious that this change brings about an increased societal demand for academic qualifications and that this demand also leads to an upvaluation of university education, this conclusion, to our mind, ultimately proves to be ambivalent. One reason is that "scientification of work" is not identical with an 'academisation of jobs'. While 'academisation' describes an increase of academic titles among the workforce within a particular domain, 'scientification' depends on the concrete practices realised by professionals in a specific field. Both tendencies can therefore be at odds.

Furthermore, with regard to epistemic and learning cultures, university education is not a homogeneous phenomenon that could be recommended simply as a remedy or judged as an impairment to such scientification. The reason is that the university as a public institution is not only (and has never been) a site where scientific knowledge is created, approved or falsified and that it also functions as an institution of the modern state. Therefore, the affinity of the university to scientific research methods (searching, testing, analysing, calculating) is only *one* element, whilst universities also have a "boundary function" with regard to disciplines and to the 'production' of professional expertise and experts' "jurisdiction" (Abbott 1988), i.e. their control and hegemony to diagnose problems and provide treatments within a certain domain. This function is not entirely determined by the ideal of science to produce objective truth or objective knowledge but also to connect to hegemonic conceptions of problems and their treatments. Specialists (i.e. different forms of high-skilled labour) that are organised as professions, some-

times only as "would-be professions", compete with each other – a competition that Abbott defines "via the cultural reconstitution of human problems": the cultural reservation of problems to a particular profession to solve these. For example: "fatness must be turned into the disease of obesity, drabness into the architectural challenge of style, and so on" (Abbott 2010, p. 175). Only those professions that have an influence on the common sense to determine problems the way they see them, i.e. with their own kind of knowledge, will be recognised with their specific academic skills as being responsible for skilled work. Accordingly, in recent times, another aspect of the universities' function can be observed which is connected to an aspired supply of flexible 'knowledge workers'. They have obtained an academic title but the crucial question is whether they dispose of "jurisdiction" as a member of a profession. Even with academic qualifications, they are vulnerable to lose and suffer from a lack of influence and power to develop professionalism if their abilities are only commodities prone to the contingencies of the market – sometimes demanded, sometimes ignored depending on the ratio of supply to demand). Seen from a certain 'neo-liberal' point of view, university education proves functional if it 'produces' such agile, flexible, self-entrepreneurial subjects so that a market of high-skilled labour flourishes. Higher qualifications, however, may lose their connection to professionalism and professional development if academics do not find employment in their professional fields, if there is no continuous exchange with peers and if competition dominates the relationships among them.

The virulence of addressing this ambivalence can be underscored by some preliminary statistical results (Langemeyer/Martin 2014). The table below shows five different clusters that were created on an empirical basis to distinguish "occupational forms" or occupations and jobs with regard to their professional characteristics. Based on the representative data record of the German "microcensus" of the year 2009, these clusters were found through three measurable characteristics that were inferred from the sociological notion of professions: (1) the prevalence of the academic qualification among the workforce within an occupational field, (2) the degree of employees holding a permanent and fulltime position there and (3) the concentration of specifications of their professionalism (i.e. the density of same specific qualifications)[3].

3 This factor is calculated by means of Lorenz's measurement of concentration which is also used for the Gini-Index. For more information, see Langemeyer/Martin (2014).

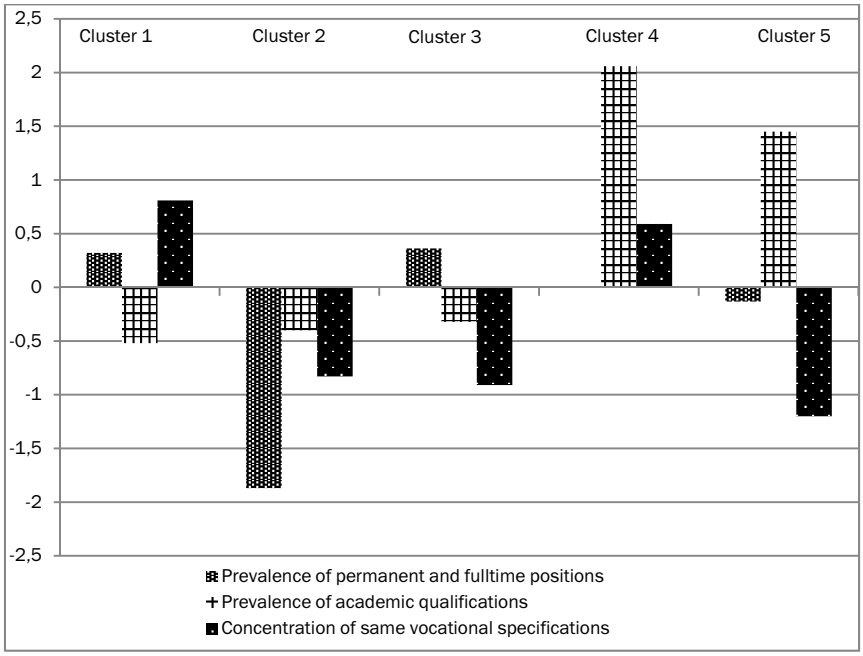
Tab. 1: Solution of five occupational clusters to distinguish forms of occupational engagement

Specialised occupations (1)	Unskilled jobs (2)	Unspecialised occupations (3)	Professions (4)	High-skilled labour without jurisdiction (5)
Operators for metal cutting machines	Agricultural workers	Professional drivers	Physicians	Marketing
Process mechanics	Warehouse and transport workers	Gardeners	Lawyers	Journalists
Turners	Janitors	Assembly workers	Judges	Consulting, counselling
Welders	Beauticians	Workers in food production	Teachers for „Gymnasien“ (grammar school)	Teachers in „Berufsschulen“ (vocational education)
Plant mechanics	Childcare workers	Shop assistants, salespersons	Architects	Humanities scholars
Nurses	Restaurant employees	Employees in sales and distribution	Engineers	Other engineers
Legal assistants	Domestic cleaners	Marketing	Pharmacists	Software developers
Assistant pharmacists	Office support personnel	Taxi-drivers	Priests	Teachers in adult education
… 115	… 33	… 72	… 38	… 14

As exemplified by the occupations shown in the table, the five clusters were found to match distinct patterns which are based on the following results of analyses (Figure 1). Their features are interpreted to represent (1) specialized occupations, (2) unskilled jobs, (3) unspecialized occupations, (4) professions, and (5) high-skilled labour without professional status or, in other words, affected by ‘marketisation’. Before explaining this technical term, the cluster solution is visualised by its features and their markedness.

‘Marketisation’ is introduced as a technical term to capture a mode of occupational regulation that is dominantly organised by the ratio of supply to demand. It is not yet possible to speak of ‘marketisation’ as a measurable societal tendency in terms of an increasing number of work relations *formerly* subject to regulations either organised by professions or by companies’ hierarchical structures (Freidson 2001). This would need further analyses. However, against the background of Freidson’s distinction of different organisa-

Fig. 1: Features and their distinction over the five clusters



tional principles (hierarchy, profession, market), the five above clusters are useful for an analysis of in what ways the market may play a role for workers' occupational status. By using data from the microcensus, two forms of 'marketisation' can be found. Indicators are (1) the self-entrepreneurial status of a worker ("single autonomy"), (2) the prevalence of fixed-term contracts, (3) the duration of the latest work contract, (4) the standard deviance of working hours, (5) the standard deviance of workers' income, and (6) the aggregation of unemployment in an occupational field. These items are provided by the microcensus data and can be interpreted as being relevant to forms of marketisation because (1) self-entrepreneurs are more likely to be affected by risks and contingencies of markets, (2) the lack of permanent positions makes them vulnerable to precarious living conditions, (3) the aggregation of short work contracts impairs their capacity to plan their professional development and career, (4) the variance of hours hired to work, (5) the variance in wages indicates a more flexible form of employment, and (6) the aggregation of unemployment implies that workers are more often entangled with job hunting than others and thus suffer more often from unfavourable conditions of the labour market.

These indicators can be subjected to a factor analysis to explore latent dimensions. Two factors can be extracted:

Tab. 2: Factor analysis of forms of marketisation

	Factor1	Factor2	Item Scale	Item Scale
Single autonomy/ self-entrepreneur	-.111	.794	.464	
Fixed-term contracts	.791	-.098		.565
Duration of the latest work contract	-.840	-.141		.591
STD working hours	.289	.788	.520	
STD income	-.041	.711	.407	
Unemployment	.676	.019		.374
Alpha			.652	.668

The first factor can be interpreted as a mode of marketisation which is dominantly precarious while the second factor discerns marketisation as a relatively self-dependent mode of occupational engagements.

Tab. 3: OLS regression analysis of the two factors with regard to the five clusters

	OLS – Precarious marketisation	OLS – self-dependent marketisation
Specialised occupations (1)	-.073 (.070)	-.346*** (.091)
Unskilled jobs (2)	.782*** (.148)	.977*** (.194)
Unspecialised occupations (3)	-.144 (.113)	.233 (.147)
Professions (4)	-.350* (.140)	.895*** (.184)
High-skilled labour without 'jurisdiction' (5)	.125 (.212)	1,129*** (.278)
R^2	.150	.157

As shown in Table 3, the two factors reveal to a certain degree in what ways the workers are affected by forms of marketisation. In many ways, the results meet common-sense expectations: Specialised occupations are much better protected from marketisation while unskilled jobs highly correlate with it.

Most salient, however, is the outcome that precarious and self-dependent forms of marketisation have different correlations within the five clusters. In the case of professions, there is a significant negative correlation with the first and a highly significant positive correlation with the second one. Moreover, by comparing professions and "high-skilled labour without 'jurisdiction'", we can see that professionals in this cluster are more likely to be affected by precarious marketisation. Further analyses are needed to tackle the questions that can be inferred from these insights: First, in what ways does the occupational form influence the ways scientific knowledge can be used and approved to be relevant to determine and solve societal problems; second, in what ways are academic qualifications recognised and how do they contribute to workers' employment status, and third, in what ways can scientific knowledge be part of the development of professionalism and expertise.

4. Conclusion

In the above sense, further research is needed to investigate socio-historical changes with regard to universities, academic education, and the scientification of work. It is not yet clear whether our society can solve the problems of the scientification of work by academisation, whether the scientific-technological development is simply upvaluating university education, or whether and in what way the labour markets of high-skilled labour are at the crossroads. However, the discussion of concrete societal problems of the scientific-technological development and the first empirical analyses of occupational forms and their marketisation should highlight the significance of taking a closer look at these issues. Our analytical differentiations underscore that further exploration of empirical data is needed.

It is not predictable what role the university will play in the future. Given that universities will still be responsible for academic titles, their societal 'fate' on labour markets needs to be investigated. Will it be important to distinguish academic from non-academic knowledge by titles from the university? The societal power and influence of academic titles are not under the control of the universities. This is mainly due to the fact that 'jurisdiction' is not provided immediately by academic qualifications. The debate on the transformation of the university in the 21st century should not stop where we detect paradoxical influences of a certain economistic way of thinking and regulating imposed onto the academia. What is missing in the light of the development of a 'knowledge society' is a debate on the reconciliation of both functions of the university or at least to find a new, more inspiring and more democratic arrangement with both, academisation and scientification of work.

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