

INFLUENCE IN DECISION-MAKING
AND THE PERFORMANCE OF RESEARCH UNITS

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ZUSAMMENFASSUNG

Der Artikel befaßt sich mit Beziehungen zwischen der Entscheidungsmacht verschiedener hierarchischer Ebenen und der Leistung von Forschungsgruppen an Universitäten und in der Industrie. Die Daten entstammen dem österreichischen Teil einer von der Unesco koordinierten internationalen Vergleichsstudie über die Organisation und Effektivität von Forschungseinheiten. Zunächst wird zwischen den beiden zentralen Dimensionen eine Verknüpfung auf theoretischer Ebene hergestellt. Im Mittelpunkt stehen der Grad der Ausschöpfung von Fachwissen, die Adäquanz von Koordinationsformen und die Verfügbarkeit von Ressourcen als eher strukturelle Faktoren einerseits, sowie Auswirkungen auf Motivation und Entscheidungslegitimität als mehr personenbezogene Faktoren andererseits. Unter Verwendung verschiedener Einflußmaße und unter Berücksichtigung von Positionseffekten bei deren perzeptiver Messung werden die vorgebrachten Hypothesen auf bivariater und multivariater Ebene empirisch geprüft. Die Ergebnisse weisen - grob zusammengefaßt - darauf hin, daß das Ausmaß an Einfluß, das von der Forschungsgruppe als ganzes auf die sie betreffenden Entscheidungen ausgeübt wird, einen positiven Effekt auf die meisten Leistungsdimensionen hat.

SUMMARY

The paper is concerned with the relation between influence in decision-making and the performance of research units working in Austrian universities and industrial organizations. Data are drawn from Unesco's First Round International Comparative Study of the Organization and Performance of Research Units. A mediation between the two sets of variables is first established by theoretical arguments. They concentrate on the acquisition of expert information, the adequacy of coordination mechanisms and the disposal of resources as more structural factors on one hand and the effects on moti-

vation and legitimacy of decisions as more individual factors on the other hand. Distinguishing different concepts of influence and taking into consideration position effects in their measurement, the hypotheses are evaluated on a bivariate and multivariate level. The results indicate - as a very gross summarization - that the amount of influence exerted by the research unit as a whole on decisions which are of concern to it has some positive effect on most performance dimensions.

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INTRODUCTION

Influence is a notion widely used in the context of the study of power and authority, which in itself has a long and manifold history.¹⁾ One of the most influential contributions to a theory of power stems from Max Weber and his attempt to conceptualize the various phenomena in the context of power became a milestone. He uses the concepts power and influence as supercategories, which comprise various more narrowly defined forms of 'realizing one's will in a social relation' like 'authority' or 'Herrschaft'. Weber's well-known definition of power (and of influence as well as I would interpret him) is "the chance of a man or a number of men to realize their own will in a social relation, even against the resistance of others, no matter on what this chance may be based."²⁾

Despite the many followers this conception has found, I ought to mention also one of the main lines of criticism. Objections are made primarily against the restricting condition of a more or less direct interaction, which the Weberian definition is supposed to include (Hondrich 1973, Baldus 1975, Murphy 1982).³⁾ What various critics strive for in different ways is a more macro-societal perspective of power. Attempts to cover both micro- and macrophenomena within the same framework are often related to the concept of class power in the Marxist tradition (Edwards 1981, Clegg 1981). This indicates at the same time how fundamentally the discussion of power is embedded in the context of social inequality.

But I shall not follow up this line of dispute since it would lead us too far away from the scope of our empirical analysis concerning power structures in the context of R & D activities. For this context, and particularly for the study of decision-making processes, the Weberian notion

of power and influence, respectively, still seems to provide a useful conceptual orientation. First, as I have already begun, a clarification as to the meaning of the variety of different terms concerning phenomena of power is necessary. Like Weber most of the authors, after him use the notions 'influence', 'power' and 'control' synonymously.⁴⁾ This interchangeable use with a preference for the term 'influence' and with the Weberian definition in mind, will also be hold in the following analysis.

Of greater importance, however, is the meaning of influence in decision-making in a deeper sense: it is the question whether it should be conceived (in game-theoretic terminology) as zero-sum or not.⁵⁾ One is lead to believe that this seems to depend above all on the affinity to different types of general sociological theory. Advocates of a system-functional model like Parsons take the view that influence is not zero-sum. Thus the amount of power in a system can be increased by analogy with credit creation in the economy (Parsons 1963). Those who are convinced of a conflict model disagree with such a conception and hold that influence is asymmetric. Concerning the process of decision-making, this would mean that one actor can increase his influence in the decision only at others' expense, that is, by decreasing the influence of others involved. A definite solution as to the validity of these opposing views faces the problem that the total amount of influence finally depends on the conceptual and operational definition.⁶⁾

Bacharach and Aiken (1976) have grounded their arguments for influence being a non-zero-sum concept on the distinction between 'authority' (formally constituted power) and 'influence' (based on formal and extra-formal sources). Since the operationalization of influence in the Unesco study, as will be shown later, corresponds to this notion of influence,

their arguments seem to be transferable. The essential difference between authority and influence lies in the fact, that the first is characterized by ultimate decision competence, while the latter lacks this attribute. This difference and the dynamic character of influence, which may involve numerous interactions, lend support to the assumption that this concept of influence in contrast to authority, can be conceived as variable or non-zero-sum.

Empirical research on influence in organizational decision-making usually takes into account both concepts of influence as discussed above. Since Tannenbaum and Kahn (1957) developed the 'control graph technique', the two different concepts are analyzed under the aspects 'total amount of influence' versus 'distribution of influence'.⁷⁾

THE RELEVANCE OF INFLUENCE IN DECISION-MAKING FOR THE PERFORMANCE OF RESEARCH UNITS

Previous Empirical Results

Most of the previous analyses on the relation between structures of influence and various dimensions of performance pertain to the research on participation.⁸⁾ The overwhelming majority of investigations has been done in the realm of industrial and business organizations whereas corresponding inquiries on research and development organizations are still rare. Early studies (Likert 1961, Tannenbaum 1961, Smith & Tannenbaum 1963, Bachmann et al. 1966, Argyris 1972) found that decentralized, participative forms of organizations were most conducive to effectiveness - both from the perspective of the organization and the employee. In other words, the total amount of influence of various hierarchical levels was positively related to performance. In a more recent investigation by Pennings (1976) the total amount

of control appeared to be the best predictor of various influence indicators. But the influence of lower levels in the organizational hierarchy also showed a clear positive relationship with organizational effectiveness as did the degree of autonomy of organizational subunits. Finally McMahon (1976) reports an interaction effect among the two basic aspects of influence in their positive relation with productivity and individual satisfaction: those subunits which were characterized both by a high total amount of influence and by a rather equal distribution of influence among hierarchical levels outranged the others.

Since Alutto et al. (1972) and Mulder (1971) have found that the interest in participation in decision-making increases with education and professional qualification, the findings from industrial organizations seem to be at least of similar importance for the R & D context. Indeed Smith (1970) reports an analogous positive relation for a research laboratory engaged in petroleum engineering. But the results had to be qualified: the more practical contributions were required, the more consultation and decision making seemed to benefit from formal organization. When more science-oriented achievement is the goal, traditional consultation and decision-making do not allow the best performance. In this case the expertise of lower level echelons can promote performance through their adequate influence in decision-making.

The most extensive analysis of the relation between patterns of influence and performance in different institutional contexts of R & D activities stems from Pelz & Andrews (1966). On the whole, their results correspond to those just mentioned. Moreover the findings indicate a similar interaction effect between the total amount and the distribution of influence like the one reported by

McMahon (1976): the higher the influence of the individual researcher was and the more sources of influence were involved, the higher was the productivity and effectiveness.

Finally one of my colleagues from Unesco's First Round international research team, Salomea Kowalewska, has studied the patterns of influence and their relation to the performance of R & D units in the extensive international data set (Kowalewska 1979). Her findings are in line with those reported for the R & D context up to now though the relations are only of a very modest size. Moreover the results have pointed to a question to which enough attention has so far not been paid. It is the question of perceptual measurement of influence, particularly the problem of perceptual disagreement among persons and some consequences for the assessment of the relation with performance. I have regarded these matters during the analysis the results of which will be reported later.

Theoretical Arguments (Hypotheses)

First I will unfold theoretical arguments for the generally positive relationship between participative, decentralized patterns of influence and the performance of R & D units and take into account also some disturbing or opposite effects. These considerations will serve as hypotheses for my own empirical analysis. The arguments can be systematized in the following way: first it is attempted to elaborate factors which relate to the specific character of scientific labour processes. This may be regarded as a kind of structural approach, concentrating on more 'objective' factors. Then I will focus on aspects relating to the internalized professional orientations of scientists and engineers. This second line of arguments may be characterized as a 'person-oriented' approach including more 'subjective' factors.

1. Maximal Utilization of Expertise

The transfer and processing of information evidently is one of the key elements for the effective functioning of any organization. As Luhmann (1968, 43) has pointed out, the 'structuring of organizations by a single type 'of communication', like the emphasis on downward communication in bureaucratic hierarchies, prevents the emergence of new forms of vertical cooperation. This type of communication and cooperation among hierarchical levels is detrimental in the presence of highly specialized work roles. On the other hand, Likert (1961) has showed that a compensating 'open door policy' does not suffice to obtain all necessary information from lower levels. This holds all the more since particularly the organization of R & D activities is characterized by a hierarchical structure which Offe (1974, 24) has termed 'task-discontinuous status-organization': this notion means that superior echelons tend to have not complete or even no command of their formal subordinates' expertise, with the consequence that the expert knowledge at lower levels relatively gains weight. This is of more importance, the more dynamic the R & D context is, that is, the more innovations are produced or have to be incorporated (Hondrich 1973, 136).

These considerations suggest that an adequate participation of scientists and engineers in R & D decision-making are conducive to the overall organizational effectiveness.

2. Adequate Coordination Mechanisms

Another connection between structural characteristics of the labour process in R & D and patterns of influence can be established through the question of adequate modes of coordination.

Various organizational sociologists have shown that different mechanisms of coordination involve distinct advantages (as to efficiency, conflict resolution, quality of task performance etc.) as well as shortcomings such as increased costs, loss of information, information distortion, information overload, decrease of motivation etc. (Tannenbaum 1974, Carzo & Yanouzas 1969, Rosengren 1964).

Two fundamental types of coordination have been distinguished by March & Simon (1958, 158): 'feedback' and 'programming'. Thompson (1967) has labeled the two concepts as 'mutual adjustment' and 'standardization' respectively. He related them to distinct task structures according the varying degrees of task interdependency. The relevant argument for our context is, that with increasing complexity of task interdependency coordination mechanisms in addition to those by formal rules and planning are required which tend to weaken the advantage of formal hierarchization. In such situations horizontal contacts and information flows among individual participants of a complex labour process as well as among work groups come to the fore. The argument has been extended to the role of task variety and the degree of uncertainty of task performance (Hage 1974, Van de Ven 1976): as the variety and uncertainty of tasks increase, the mutual feedback type of coordination seems to ensure higher effectiveness than coordination through hierarchy and impersonal programming.

The validity and meaning of these assumptions for the R & D context seems to be evident. Though R & D tasks and projects may vary widely with respect to the crucial factors task interdependency, task variety and task uncertainty, as a tendency the level of these variables supposedly is relatively high in the R & D context. On the other hand the mutual feedback type of coordination, which thus would be indicated for a good deal of R & D activities, seems to

have important implications for influence structures: one can understand that such a coordination mode owes its larger capacity for fast error adjustment and timely changes of course not the least to the precondition that the scientists and engineers directly involved into the project have a fairly high say in these mutual work adjustments.

3. Disposal of Resources

The availability of adequate personnel and material resources is a fundamental prerequisite of a research unit's work. Especially in technology-intensive parts of R & D expensive and complicated equipment is required. On the other hand financial resources are usually scarce. This leads to a more or less open competition among organizational subunits for priority as to requested equipment and services.

Against this background the structure of influence plays an important role. It can be assumed that a unit or a leader with generally high influence will be more successful in the competition for specific personal or material resources than a unit or a leader with low influence.⁹⁾ Therefore it is supposed that a high level of influence on the part of a research unit as a whole or of its leader facilitates the performance of a unit through the relatively better access to or disposal of adequate resources.

4. Increased Motivation

Apart from the expertise argument, the emphasis of motivation, feelings of autonomy and self control is one of the most frequently used explanations of the positive relation between widely dispersed influence and organizational performance.¹⁰⁾

The argument that the characteristics of bureaucratic organization are in contradiction to the norms and values of professionals is widely held.¹¹⁾ Its content is that a formal authority structure, formal rules and control mechanisms tend to conflict with the claim to far-reaching autonomy in work as it has been internalized through professional socialization and which includes an emphasis on intrinsic motivation. This conflict can partly be tempered by linking professional authority with formal authority. However, insofar as interferences into the immediate area of work reduce their own margin for decisions, professionals usually react with a decrease in motivation. Thus the assumed high intrinsic motivation can be modified extensively by organizational conditions. It can be stimulated by adequate working conditions as well as hampered by damages to autonomy.

It seems to be reasonable that the motivation of professionals like R & D personnel can be increased or at least maintained by adequate involvement in decision-making. This leads to the hypothesis that a high level of influence in work related matters would enhance a researcher's motivation to cooperation as well as his responsible performance of tasks. Though one cannot regard such a motivation as sufficient for the appearance of high performance, it seems to be a substantial precondition. Among the many empirical evidences those from Pelz & Andrews (1966) are of immediate interest here.

5. Increased Legitimacy of Decisions

In addition to increased motivation another factor on a more individual level might play an important role: it is the legitimacy of decisions. This aspect also has to be seen in the light of the remarks on the relation between

professionals and bureaucratic organizations. Since professional groups like the R & D staff tend to deny authority which is only formally legitimized, the quality of legitimacy becomes a vital question.

The high degree of specialization and the mentioned 'task-discontinuous status organization' entail the disintegration of professional and formal authority. This gap has to be bridged somehow, otherwise the formal authority linked with a particular position is undermined. Such tensions in the authority system cannot be conducive for effectiveness, but they can be largely reduced. It is agreed that for scientists and engineers the professional authority is the most readily accepted basis of legitimacy. Thus an increase of the legitimacy of decisions should be gained by there being adequate chances for the whole R & D staff to participate in decisions which are of concern to it. Such a participation enables a reduction of conflict which results to some extent from the timely involvement in and engagement for particular decisions.¹²⁾

The hypothesis then is the following: a high level of influence exerted by the R & D personnel on matters which are of concern to it increases the legitimacy of decisions. This reduces unproductive conflict and increases loyalty from which a favourable impact on the overall organizational effectiveness can be expected..

6. Potential Opposite Effects

Finally it has to be pointed to factors potentially disturbing the assumed advancement of performance brought forward in the above considerations.

One of the potential negative effects on organizational effectiveness which might be entailed in a broad dispersion of influence and participation in decision-making is the danger of information overload. Indeed this represents the reverse of the acquisition of expertise by increasing the influence of the R & D staff as a whole. An excessive supply of suggestions obviously increases the selection work in decision-making. But whether in sum the advantages outweigh the disadvantages for effectiveness cannot be determined generally. Since ultimate decision power is still formally regulated, it depends on the practical solutions of the problem.

Another negative effect produced by a high level of autonomy of any subunit might be, at least from the point of view of the organization leaders, the danger of goal shift. In industrial R & D, postponing of application-oriented in favour of scientifically interesting endeavours would be an example. Again one can say that a broad dispersion of influence does not necessarily allow such a high degree of individual or group autonomy. Moreover, the formal authority structure usually provides enough mechanisms of control and sanctions to ensure goal conformity.

Having sketched the main arguments concerning the relation between influence in decision-making and organizational performance, the following résumé can be made: a high level of influence of scientists and engineers, irrespective of their formal status, in decisions which are of concern to them, particularly in work related decisions, seems to be conducive to the effectiveness of their R & D activities. In the following section the results of my empirical analysis are presented. The main objective was to check the assumptions as to the effects of varying influence in decision-making as was pointed out in the preceding pages.

DATA AND MEASURES

The data stem from Unesco's First Round International Study of the Organization and Performance of Research Units.¹³⁾ The international data set comprises data collected from 1222 research units in Austria, Belgium, Finland, Hungary, Poland and Sweden. My analyses concentrate on the Austrian subset and were conducted separately for 91 research units in industry and 118 in universities. The industrial units consist of 81 working in technological sciences and 10 in chemistry. The majority of the university units pertain to technological sciences (32), one to astronomy while the rest is almost equally distributed among physics, chemistry, biology and geology. The analyses examine data at the unit-level.

Measures of Influence

The measurement of influence is based on perceptual ratings. Respondents (scientists and engineers inside the unit, unit head) were asked to rate the amount of influence that he (she) believed certain groups of individuals exercised over each of nine specified types of decisions. The ratings were made on the basis of a five-point scale ranging from 'low influence' to 'high influence'.¹⁴⁾ The amount of influence exercised by the following four groups was assessed:

(1) unit heads, (2) other scientists and engineers in the unit, (3) organizational leaders outside the research unit but within the organization to which the unit belonged, and (4) authorities or customers outside the organization.

The data contain 36 distinct assessments of influence for each respondent, so that there were finally 72 distinct influence values for each unit since ratings from unit heads and the aggregated assessments from staff scientists

were analyzed separately. This mass of detailed information had to be reduced to a compact form by means of multidimensional scaling. The result are composite measures of influence that were also used in the analyses of the Austrian research team. The influence measures that are used in my analysis were chosen on the basis of the following considerations:

The four hierarchical levels, the influence of which had to be assessed, cannot be treated as analogous to the hierarchy in an industrial organization. The reason is that they do not really represent a consistently functioning hierarchy. That is, they explicitly include one extra-organizational source of influence ('clients and authorities'). Moreover it is questionable whether the top leadership of the organization itself in practice controls the work of research units. Therefore it did not seem very reasonable to put too much weight on Tannenbaum's control graph technique as an orienting analytic tool. The consequence was that the analyses do not concentrate on the difference between the distribution and the total amount of influence. This is also supported by the results of Kowalewska (1979), who found the distribution of influence inside the unit as irrelevant for its performance while the distribution between the unit and organization leaders trended in the same directions as the total amount of influence exercised by the research unit as a whole.

Under these conditions indices of influence seemed to be appropriate which tapped on one hand the amount of influence that was exercised by the distinct sources over various areas of decision, on the other hand the total amount of the research unit as a whole. The following indices were used in the analysis:¹⁵⁾

(1) Influence on research decisions

This measure combines the ratings of the following items

- choice of specific research tasks
- choice of methods used
- publication and circulation of research results

(2) Influence on coordination decisions

- allocation of work within the unit
- coordination and/or cooperation with other units

(3) Influence on decisions in personnel policy

- hiring personnel for a definite period
- termination of employment of personnel

(4) Average amount of influence

This global index measures the average influence on the basis of all nine single items.

These four indices exist separately for each of the three hierarchical levels within the organization and the index for the averaged influence also for external sources. Moreover, there are separate versions according to the formal status of the respondent: one set expresses the perceptions of staff scientists (SB), the other those of the unit heads (SA).¹⁶⁾

(5) Total amount of influence of the research unit

This measure combines the amount of influence that is exercised by the unit head and the staff scientists together over the whole range of decisions as listed in the questionnaire. An SA and a SB version exists for this index as well.

The reason for the construction of separate influence measures according to the hierarchical level of the respondent was twofold. The first is a theoretical one: since influence (or power) always involves interest, the perceptual measurement of influence is subject to such an interest bias. According to that a tendency towards downgrading of influence can be assumed, the motives to do this being different. Less powerful actors might describe their influence as still lower in order to increase their chances for a power-equalization. Powerful people might do so as well, but in order to increase their chances to preserve their level of influence. Therefore it seemed to be reasonable to control for hierarchical position in influence rating. A second reason to do this was an empirical one: correlations among the SA and the SB influence ratings were indeed rather low. Implications of this control of the respondents' formal status are an important point in my investigation.

Performance Measures

Four qualitative and two quantitative measures of the research unit's performance are used in the analysis. These indices again comprise a number of single items as listed in brackets and are based on aggregated ratings:¹⁷⁾

- (1) Recognition
(international reputation, demand for publications)
- (2) R & D Effectiveness
(productiveness, innovativeness, contributions to R & D objectives of the organization)
- (3) Administrative Effectiveness
(meeting time schedules, staying within the operating budget)

- (4) Applications Effectiveness
(follow-up of research results or practical application, application of experimental developments)
- (5) Publications
(books, articles, reviews and bibliographies)
- (6) Patents and prototypes
(patents, experimental prototypes and materials, prototype computer programmes).

Having described the data-base and central measures, the basis for the display of the analysis results has been laid.

RESULTS

Separate Rating of Amount of Influence

A first impression of the relation between influence in decision-making and the performance of research units in our data is shown in Table 1 and 2, respectively. They contrast the relations as based on unit heads' ratings of the amount of influence with those stemming from staff scientists. One can see from Table 1 and 2 that on the whole the correlations between the averaged influence indices and performance measures are rather low. This holds less for those based on unit heads' ratings than for the SB-set. However, it is interesting that there appears a rather consistent pattern: the relations of the two sources of influence inside the unit tend to be positive, whereas among the relations of the two levels external to the unit negative coefficients are predominant. The

Table 1: Average influence on the basis of separate ratings in relation to performance measures (academic research units, Pearson's r)

	Performance measures					
	Recognition	Administrative Effectiveness	R & D Effectiveness	Applications Effectiveness	Publications	Patents & Prototypes
<u>Unit head's ratings of influence of:</u>						
Scientists & engineers	.05	.12	.15	-.07	.13	.03
Unit head	.19*	.18*	.37*	.17*	.00	-.07
Organization leaders	-.24*	-.09	-.06	-.12	-.11	-.13
Extraorganizational sources	-.10	-.05	-.16*	-.12	-.18*	-.16*
<u>Staff scientists' ratings of influence of:</u>						
Scientists & engineers	.08	.01	.18*	.03	.13	.13
Unit head	.15	.08	.14	.10	-.04	.07
Organization leaders	-.04	-.11	.06	-.07	.12	.11
Extraorganizational sources	-.04	-.07	-.10	.04	-.03	.12

*) Significant at the .05 level of confidence

Table 2: Average influence on the basis of separate ratings in relation to performance measures
(industrial research units, Pearson's r)

	Performance measures				
	Recognition	Administra- tive Effec- tiveness	R & D Effectiveness	Applications Effectiveness	Publi- cations & Patents Prototypes
<u>Unit head's ratings of influence of:</u>					
Scientists & engineers	.39*	-.12	.27*	.12	.31*
Unit head	.19	.00	.14	-.04	.23*
Organization leaders	-.06	.18	-.05	.22*	-.22*
Extraorganizational sources	.16	.03	-.19	.12	.05
<u>Staff scientists' ratings of influence of:</u>					
Scientists & engineers	-.03	-.06	.12	-.05	.00
Unit head	.11	.00	.13	.10	.18
Organization leaders	-.23*	-.04	-.18	-.26*	-.20*
Extraorganizational sources	-.07	.18	-.30*	-.05	-.12

*) Significant at the .05 level of confidence

only deviance of this rather clear overall picture is indicated with respect to the relation to 'administrative effectiveness' and to 'patents and prototypes': as to administrative effectiveness, the relation as characterized above tends to be the reverse for industrial units. On the other hand, the relation to patents and prototypes is inconsistent for academic units.

In a next step, the validity of this first impression was checked by introducing conditioning variables into the analysis. According to the theoretical considerations two key variables were selected which showed considerable correlations with some performance measures: 'atmosphere' and 'facilities'. The partial order correlations controlling for these two factors successively are displayed in Table 3. The control is limited to the relations based on the SA-set (unit head's ratings) because the SB-set had showed too low and more inconsistent correlations. ¹⁸⁾

Table 3: Partial order correlations among influence and performance measures, controlling for 'atmosphere' and 'facilities' (unit head's ratings of influence, Pearson's r)**)

	<u>Performance measures</u>											
	Recognition Effectiveness	Administrative Effectiveness	R & D Effectiveness	Applications Effectiveness								
				Publications	Patents & Prototypes							
<u>Academic research units</u>												
Amount of influence exercised by:												
Scientists & engineers	.01	.04	.11	.12	-.10	.15	-.12	-.08	.14	.13	.09	.03
Unit head	.12	.16	.15	.14	.28*	.35*	.10	.16	.02	.00	.04	-.07
Organization leaders	-.26*	-.22*	-.10	-.05	-.08	-.04	-.14	-.11	-.11	-.11	-.12	-.13
Extraorganizational sources	-.10	-.07	-.05	.00	-.16	-.13	-.12	-.09	-.18*	-.18*	-.17	-.16
<u>Industrial research units</u>												
Amount of influence exercised by:												
Scientists & engineers	.38*	.37*	-.17	-.19	.20	.27*	.03	.13	.34*	.31*	.26*	.28
Unit head	.18	.15	-.03	-.10	.07	.13	-.14	-.03	.25*	.23*	.16	.19
Organization leaders	-.08	-.08	.15	.15	-.14	-.06	.15	.23*	-.21*	-.22*	-.07	-.05
Extraorganizational sources	.18	.27*	.06	.20*	-.15	-.18	.19	.11	.04	.07	-.07	-.12

*) Significant at the .05 level of confidence

***) The first figure represents the partial correlation coefficient controlling for 'atmosphere', the second for 'facilities', respectively.

A comparison of Table 3 with the zero order correlations in Tables 1 and 2 indicates that the overall pattern of relations is preserved. Yet the two conditioning variables indeed seem to count to some extent for the correlations between amount of influence and performance measures. Partialling out the effects of the general atmosphere in the unit and the availability of various facilities leads to a slight reduction of the zero order coefficients. This holds particularly for the effects of 'atmosphere'. Nevertheless almost all relations between the amount of influence of unit heads and staff scientists on one hand and performance measures on the other hand remained positive. They were stronger and to a greater extent significant for industrial units. The negative tendency of the relations of the sources of influence external to the unit with most performance measures except for administrative and applications effectiveness in the industrial data is in accordance with the zero order correlations as well.

However, it must not be forgotten that the analogous relation on the basis of the staff scientists' influence ratings did not show quite as clear a picture. The question of how to handle this problem seemed to require above all a look at the relations among the SA and SB versions of influence ratings.

The first result was that none of the interrelations among the SA and SB influence indices exceeds a value of .50 (Pearson's r) and many were even close to zero. This led the analysis still one step further back to the comparison of the averaged influence ratings of the two hierarchical groups, unit heads and staff scientists. The pattern of the distribution of influence over the four hierarchical levels was congruent among the SA and SB ratings. However, what was puzzling was a phenomenon concerning the assess-

ment of the amount of influence that was exercised by staff scientists over the various types of decisions: unit heads rated the influence of other scientists in the research unit consistently higher than those did themselves.¹⁹⁾ This can be seen from Table 4.

Table 4: Average influence of staff scientists in academic and industrial research units (separate ratings, means)*)

Areas of decision	<u>Academic units</u>			<u>Industrial units</u>		
	Ratings by unit heads	Ratings by staff scientists	Difference	Ratings by unit heads	Ratings by staff scientists	Difference
Research work	4.1	3.4	.7**	3.3	3.0	.3**
Coordination	3.9	3.3	.6**	3.2	2.8	.4**
Personnel Policy	2.5	2.0	.5**	2.0	1.8	.2
All areas	3.7	3.0	.6**	2.9	2.6	.3**

*) Low influence = 1, high influence = 5

***) T-Test, significant at the .05 level of confidence

The results clearly indicate a significant dissent with respect to the amount of influence that is exercised by staff scientists. The origin of this dissent is not immediately evident. It seems to have something to do with the involvement of interests as has been mentioned above as well as with real barriers to and distortions of communication. But in connection with a second interesting pattern some potential causal mechanisms will become plausible. What has been found additionally, was that the distance between the amount of influence of the unit head and that of staff scientists turned out to be always lower within the ratings of unit heads than by those of the

scientists and engineers. This indicates a discrepancy of perception which is different from the first mentioned in the following respect: it can be interpreted as an intra-personal discrepancy whereas the other was an interpersonal one. This brings in a line of interpretation which is based on the pressure towards the legitimation of power: as far as one can assume the existence of such a pressure towards legitimation for the leaders of research units, the reported finding can be explained as an expression of it. Whether such a pressure emanates from underlying role expectancies or from political values or whatever must be left undecided in this context.

Having pointed to some of the problems entailed in bringing together the influence ratings of unit heads and staff scientists, I will return to the relation with performance and the suggested solution considering the analysis of it.

Relations with Performance on the Basis of Congruent Influence Ratings

This approach is characterized by the fact that the analysis has been restricted to those units for which the two groups of respondents to the influence questions fairly well agreed with respect to their ratings. By this strategy the findings of the first step of the analysis ought to have been checked. The technical procedure which allowed this was a simple one.²⁰⁾ The influence indices were dichotomized at the median, thus being split into the categories 'low influence' and 'high influence'. On this basis the SA and SB ratings were cross-tabulated so that for each cell the means of the various performance measures could be computed. The diagonal containing the average performance for those cases where the SA and SB ratings of influence were congruent represented the relevant data. Then the values from these two cells

were contrasted: the mean performance of the subset of units where the head in accordance with staff scientists had rated low influence was compared to the mean of the subset where both had rated high influence. This was done for each type of decision, each source of influence and each performance measure.²¹⁾

I shall spare the reader the fruits, and myself the labour of a detailed demonstration of all the results. This seems to be justified by two trends in the results of this procedure: first, the pattern that has emerged during the separate correlational analysis for the SA and SB data set, appeared still more pronounced. Second, there were no differences as to the type of decision worth mentioning except for the case of decisions on personnel policy with industrial research units (here the relations to performance turned out to be less consistent).²²⁾ So the main result may be summarized verbally and then supplemented graphically concerning the relation between the total amount of influence of the unit and its performance.

For academic units the amount of influence of scientists and engineers as well as that of the unit head (usually a university professor or head of a university institute) is positively related to virtually all performance measures. The amount of influence of organization leaders, on the contrary, tends to be negatively related with performance, except for a slightly positive relationship to the administrative effectiveness. The same holds for extraorganizational sources, yet instead of administrative effectiveness it is applications effectiveness which is the only positively related performance measure.

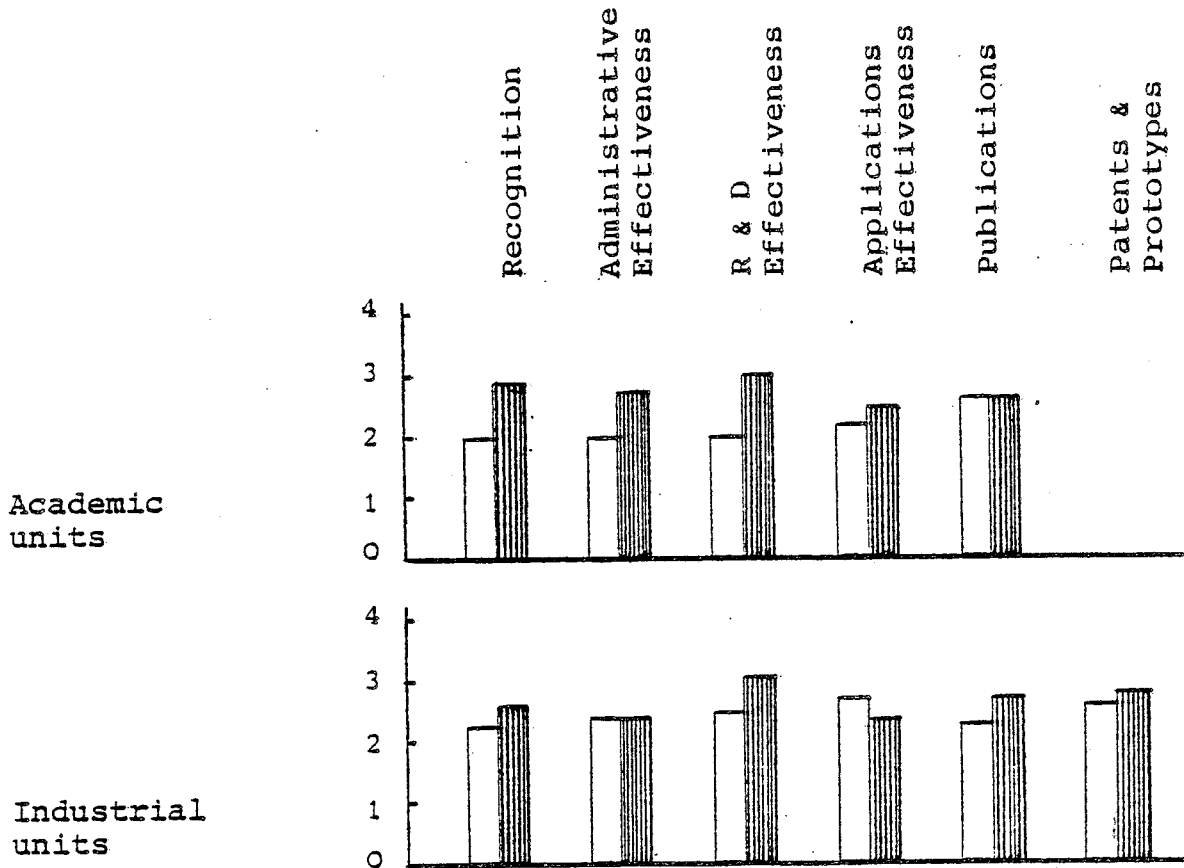
For industrial units, the relation between the amount of influence of scientists and engineers on work related

decisions and all kinds of performance measures is the most pronounced of all relations. In contrast to that, the relations for the case of personnel policy decisions show no systematic pattern. Concerning the influence of unit heads, it appeared to be slightly positively related to administrative effectiveness, R & D effectiveness, applications effectiveness and publications, slightly negatively, however, to recognition and patents and prototypes in the case of work related decisions. For personnel policy decisions the findings are inconsistent. The relations as to the influence of the organization leaders and extraorganizational sources (clients, customers and higher authorities) are also more complicated. However, there is a tendency towards negative relations with more academic performance dimensions and positive relations with administrative and applications effectiveness as well as with the number of patents and prototypes.

So, on the whole, the findings are in accordance with the theoretical arguments that have been put forward in the preceding section. To close the report on the 'congruency approach' an illustration of the results with respect to the total amount of influence of the research unit is given in the Exhibit below.

The results with respect to the total amount of influence as exercised by the research unit as a whole over decisions which are of concern to it show the following: it is clearly positively related to all kinds of qualitative performance measures of academic units, whereas no relation is to be seen concerning the quantitative measure. For industrial units there are positive relations with recognition, R & D effectiveness, publications and patents & prototypes. No relation appeared with respect to administrative effectiveness while applications effectiveness tends to be affected by a high total amount of influence as exercised by the unit.

Exhibit: Average Performance with two distinct levels of total amount of influence as exercised by the research unit (means)*)



*) Average performance levels with low amount of influence are represented by white bars, with high levels of influence by striped bars.

These findings suggest differentiating the theoretical argument in the following way: the assumed positive relation may outweigh the potential contrary effects like goal shift and information overload in the context of academic freedom. Yet for the industrial context, where organizational goals are defined more narrowly by the pressure towards commercialization, with increasing degree of a unit's autonomy the weight of the mentioned counter-vailing factors comes to the fore.

The Mediation of the Relation between Influence in Decision-Making and Performance

A further check of the validity of the hypotheses that were brought forward at the beginning concerned the relations of influence indices with the variables which had been introduced as the theoretical connection. The results of this check are demonstrated very briefly. The display is organized according to the main lines of the arguments: first, the relations with some dimensions that are interpretable as structural ones are displayed and thereafter those with more person-related or 'subjective' variables. Table 5 presents the results of the first part of the analysis.²³⁾

Table 5: Relations between influence in decision-making and dimensions of cooperation, communication and resource disposal (Pearson's r)

	<u>Academic units</u>		<u>Industrial units</u>	
	Amount of influence exercised by:		Amount of influence exercised by:	
	Staff scientists	unit head	Staff scientists	unit head
Cooperation	.30*	.19	.41*	.16
Research planning	.35*	.12	.24*	.23*
Contacts with supervisor	.20	.41*	.11	.41*
Supervisor's competency	.15*	.35*	.02	.17
Supervisor's overall quality	.24*	.41*	.16	.32*
Adequate Resources	.22	.41*	.05	.18

*) Significant at the .05 level of confidence

The correlations indicate a more finely-meshed net of communication going hand in hand with a higher level of influence of scientists and engineers in the unit. Such a structure is assumed to be functional for successful research work because of its capacities concerning timely error finding and correction. Moreover, the required volume of communication obviously increases with the degree of task complexity and uncertainty which is extensively the case in R & D.²⁴⁾ On the other hand, it seems to be indicated that adequate professional qualification and general supervisory qualities on part of the unit head are a precondition for allowing him to exercise a high amount of influence. The assumed positive effects of the unit head's influence as to the availability of various resources is indicated at least by the pronounced relation in the data for academic units.

Table 6 contains some of the relations of influence indices with relevant person-related variables:

Table 6: Relations between influence in decision-making and dimensions of subjective attitudes (Pearson's r)

	<u>Academic units</u>			<u>Industrial units</u>		
	Amount of influence exercised by:			Amount of influence exercised by:		
	staff scientists	unit head	unit as a whole	staff scientists	unit head	unit as a whole
Satisfaction with supervisor	.30*	.35*	.30*	.20*	.33*	.34*
Satisfaction with personnel policy	.18	.31*	.29*	.17	.31*	.31*
Interest of work	.29*	.33*	.42*	.28*	.35*	.40*
Group climate	.39*	.31*	.47*	.14	.23*	.24*

*) Significant at the .05 level of confidence

One can see from the table that the relations are always positive and to a large extent significant. Especially the influence of the unit as a whole on matters which are of concern to it shows high correlations with the various indicators of the group climate and subjective attitudes towards work in the unit. These relations are on the whole much more pronounced than those between influence and performance which is in accordance with the theoretical considerations. It confirms the hypothesis that the effects of variations in the amount of influence have not in the first place an immediate impact on performance. Rather there are direct effects on subjective dimensions as indicated above and via such factors, like motivation and involvement, on performance as well.

A Multiple Regression Model of R & D Effectiveness

The last step of the analysis was aimed at a more compact description of the role of the amount of influence as exercised by the various hierarchical levels. That is, the distinct contribution of the variation of influence of each hierarchical group, with respect to the prediction of performance, ought to have been assessed. For that purpose a multiple regression model seemed to be appropriate. It should be noted that it is not so much the goal to explain a greatest possible proportion of the performance variance by influence variables than to differentiate these types of influence as to their distinct contributions to the explanation of performance. As a representative indicator of performance I chose R & D effectiveness. The predictor variables are the indices of the total amount of influence of the research unit, the influence of organization leaders and the influence of extraorganizational sources. The results are displayed in Table 7 for academic and Table 8 for industrial units.²⁵⁾

Table 7: Multiple regression model for academic research units*)

Step	Variable	<u>R & D Effectiveness</u>			
		r	mult.R.	b	beta
Total amount of influence exercised by:					
1	Unit	.28	.28	.26	.31
2	Extraorganizational sources	-.16	.33	-.18	-.23
3	Organization leaders	.06	.34	.06	.09
		$R^2 = .12$		A=2.99	

Table 8: Multiple regression model for industrial research units

Step	Variable	<u>R & D Effectiveness</u>			
		r	mult.R.	b	beta
Total amount of influence exercised by:					
1	Unit	.25	.25	.18	.23
2	Extraorganizational sources	-.19	.30	-.14	-.16
		$R^2 = .09$		A=3.57	

*) Step-wise regression, b represents the nonstandardized regression coefficient, beta the standardized one.

From the results of the multiple regression analysis one can see the following: first, both for academic and industrial research units the amount of influence that is exercised by the unit head and the staff scientists together is the most important predictor for R & D effectiveness among the various sources of influence. As known from the preceding analyses the relation is a positive one. Second, the amount of influence exerted by extraorganizational sources, again in both research contexts turns out to be the next important predictor, the relation being negative. Third, the predictive contribution of the influence of organization leaders is already low concerning the academic data. This factor was excluded during the analysis of industrial units. This picture summarizes the analysis results of the preceding sections fairly well, though the variance in performance explained by the two models is rather low (.12 and .09, resp.). Yet, as has been mentioned, this aspect has not been the focus in the use of the regression models.

SUMMARY AND IMPLICATIONS

The results concerning the main objective, the assessment of the role of influence in decision-making for the performance of research units, were to some extent different for academic and industrial units.

For academic units (technological and other natural science disciplines) the total amount of influence that was exercised by the unit as a whole (unit head and other scientists) on various matters of concern to it showed clear positive relations with virtually all measures of performance which were used in the analysis. This counts the more since they comprise both qualitative and quantitative measures tapping

the more scientific dimensions as well as those of the applications-oriented type. On the other hand, the influence of organization leaders (usually the faculty) and that of extra-organizational sources (ministry, customers, clients) tended to be negatively related with most performance measures. Only the more applications-oriented measures showed slightly positive relations.

These findings are interpretable in the light of the theoretical arguments and the particular conditions of R & D in the academic context. Considerable influence on all matters concerning the unit seems to enhance not only, first of all, the motivation and involvement of the unit members, but subsequently stimulates performance as well. In contrast to that, the decrease in performance occurring with increasing influence from sources external to the unit has to be seen as a consequence of interferences into the work of the unit. It supposedly represents the reaction to damaged autonomy. Moreover, the arguments relating to the better utilization of expertise, the adequate mode of coordination, and the disposal of various resources are substantiated by the findings as well. Finally, the consistency of the pattern for all kinds of decision areas has to be seen against the specific academic background: it seems evident that according to academic norms personnel policy is an area of at least to some extent participative decision-making. This does not hold for the industrial context and the empirical results are in accordance with that difference.

Concerning the industrial units, the most pronounced relationship, again of a positive nature, was the one between staff scientists' influence on work-related matters and various dimensions of performance. The unit head's influence on such decisions also was positively related to the majority of performance measures, yet not very pronounced. No consi-

stent pattern of relations was found for the case of personnel policy decisions. On the other hand, as to the influence of the two sources external to the unit, a trend came to the fore, which is readily interpretable against the background of the specific characteristics of R & D in industry: a polarization of the relations with performance dimensions appeared insofar as the applications-oriented measures tended to be positively related, whereas the more academic ones showed negative relations.

Together with the reported results as to the influence of the unit as a whole, these findings led to a specification of the theoretical argument: the potential countervailing effects of goal shift, particularly, and others like information overload, have more weight in the industrial than in the academic context. The reason seems to be located in the differing nature of the goals of organizations in the two contexts. It has been discussed as the contrast between pressure towards commercialization and academic freedom.

A last point which has not been considered explicitly so far, is the question of cause and effect. It needs not be stated that the results of the analysis cannot be identified as causal relations inherent in the data. Rather a specific causal relation has been assumed according to theoretical considerations. There is no doubt either, that the analysis could be much more refined towards the testing of causal models. This would have to be extended towards dealing with the problems entailed in the perceptual measurement of influence. However, the assumed causal relation between influence in decision-making and influence seemed to make more sense than for instance the reverse: that performance would have a specific impact on the structure of influence. This does not mean that such a kind of relation cannot be assumed

reasonably. Yet my analysis has been based on the alternative assumption because of an interest in the checking of the hypotheses entailed in that approach and the data seem to lend support to it.

APPENDIX

L. PATTERNS OF INFLUENCE

Please indicate how much influence each of the following has on the research and management decisions relevant to the unit by selecting ONE number from below and writing it in the space provided according to the amount of influence

- 1 = high influence (X)
- 2 = tendency to (X) above
- 3 = "intermediate" as regards extremes (X) and (Y)
- 4 = tendency to (Y) below
- 5 = low influence (Y)

a. Influence in Research Work

	Unit head(s)	Other scientists & engineers inside unit	Leadership outside unit but inside organization	Authorities or customers outside organization
i. Choice of specific research tasks	<u>38</u>	<u>39</u>	<u>40</u>	<u>41</u>
ii. Choice of methods used	<u>42</u>	<u>43</u>	<u>44</u>	<u>45</u>
iii. Publication and circulation of research results	<u>46</u>	<u>47</u>	<u>48</u>	<u>49</u>

b. Influence on management decisions

i. Allocation of work within the unit	<u>50</u>	<u>51</u>	<u>52</u>	<u>53</u>
ii. Co-ordination and/or co-operation with other units	<u>54</u>	<u>55</u>	<u>56</u>	<u>57</u>
iii. Use of training and career development facilities	<u>58</u>	<u>59</u>	<u>60</u>	<u>61</u>
iv. Hiring personnel for a definite period	<u>62</u>	<u>63</u>	<u>64</u>	<u>65</u>
v. Termination of employment of personnel	<u>66</u>	<u>67</u>	<u>68</u>	<u>69</u>
vi. Hiring or buying low-cost equipment (value up to \$500 US per piece)	<u>70</u>	<u>71</u>	<u>72</u>	<u>73</u>

Notes

- 1) Lukes (1979) provides one of the broadest accounts on the history of theorizing on the concepts of power and authority.
- 2) Weber (1964, 38).
- 3) While Baldus, for instance, advocates a much broader definition of power (see 1975, 188), as a consequence of a perceived limitation in Weber's conception, Murphy denies the limitation of Weber's notion to direct interaction (Murphy 1982, 180). Attempting to develop the Weberian 'types' of power further, he suggests differentiating between a) power to command, b) power to constrain, and c) power to profit from. He then uses these subcategories within a theoretical analysis on the societal level.
- 4) For instance Dahl (1957, 202), Merton (1962, 418), Mechanic (1962, 351), Lammers (1968, 203), Tannenbaum (1968). A diverging view has been recently taken in a formalized approach by Abell (1982, 143), who insists on a vital conceptual distinction between 'influence' and 'manipulation' as two subcategories of power.
- 5) Lukes (1979) takes this distinction between 'asymmetric' (some can gain only at others' expense) and 'collective' (all may gain) conceptions of power as a fundamental differentiating criterion in his valuable account.
- 6) This is noted by Pennings (1976), who reports results compatible with the zero-sum concept, though he like many authors in organizational analysis, favours a non-zero-sum concept of influence.
- 7) Two other notions, widely used in organizational literature, are related to these two aspects as well: 'participation' and 'power equalization'. Compare McMahan (1976).
- 8) Dachler and Wilpert (1978) have tried to develop a general framework for the integration of the various concepts of and approaches to 'participation'.
- 9) Wager (1965) reports some empirical findings.

- 10) The theory of the 'Self-actualizing Man' and the names of Likert and Argyris stand at the center of this tradition.
- 11) It is to be regretted that it is hardly ever discussed as a phenomenon of social inequality. Clegg (1981) is one of the exceptions.
- 12) As Leavitt has pointed out, this may even entail the danger of a kind of tyranny insofar as one cannot oppose the consequences of a decision in which he once has participated (Leavitt 1965).
- 13) Results of this international study have been published in Andrews (1979). The Austrian research team at the Institute for Advanced Studies, Vienna, which has participated in this project produced an extensive national report and published the following three articles: Aichholzer et al. 1978, Knorr et al. 1979a,b.
- 14) A copy of the questionnaire-page with the questions on influence indicating the detailed phrasing is included in the appendix.
- 15) All indices were constructed additively and unweighted.
- 16) The current abbreviations for the two hierarchical levels during the First Round of the Unesco Study were 'SA' ('Scientists category A') for unit heads, and correspondingly 'SB' for staff scientists.
- 17) The qualitative measures are again assessed on a five-point scale. The quantitative ones count the number of each kind of product that was issued during the past three years by members of the unit.
- 18) The overall pattern of the zero order correlations has been confirmed by a parallel analysis that made less high demands on the scale quality of the variables involved. This was done by computing the corresponding rank-order correlations using Kendall's tau. The high degree of concurrence seemed to justify the use of Pearson's r for further analyses. This whole question of interpreting rank order scales as quasi-interval scales has been tackled more thoroughly by Labovitz (1970; 1971) and O'Brien (1979).
- 19) The same pattern was found in a further analysis using the international data set. Each of the differences was significant.
- 20) This procedure reduced the number of cases that were subject to the analysis considerably but for each cell an N of at least 20-30 units remains.

- 21) The measure 'patents & prototypes' was not used in the analysis for academic research units.
- 22) This case of deviance contrasts also with the findings of Kowalewska (1979, 183) wherein the decision area was irrelevant for performance relations.
- 23) SA and SB data in principle show the same pattern but it is more pronounced in the SB version which therefore is used.
- 24) Compare Randolph & Finch (1977).
- 25) The models are based on the SA version of influence ratings. Analyses on the basis of SB-data showed very similar results.

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