Motivational information systems have a reduced or negative effect in discontinuous situations

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Abstract

This article investigates how motivational information systems fail due to discontinuities or end effects. Motivational information systems are widely used in business contexts although only occasionally formally recognized as such. Motivation information systems contain metrics for assessing performances of anything or person from individual to organization levels, contribute to either the rewarding of performance or delivering of penalties for poor performance, and facilitate strategies for encouraging individuals to improve their performance. The intention behind creating any metric is in creating improvement in individual or organisational performance, often via an intermediary surrogate such as the performance of an object, system or process.

In practical terms, this article draws on a case analysis of motivational information systems used in a university context relating to academic staff. The selected case study presented in this paper demonstrates how normal organisational discontinuities act to wreck the intended benefits of intended motivation for performance improvement strategies and the use of motivational information systems as parts of those strategies.

The article concludes with suggestions for minimizing the problems of discontinuities in motivational information systems.

Introduction

This article explores how motivational information systems fail due to discontinuities. Motivational information systems are widely used in business contexts although only occasionally formally recognized as such. Motivation information systems are those that contain metrics for assessing performances from individual to organization levels. The intention behind creating ***any*** metric is to create improvement in individual or organisational performance, often via intermediary performance of an object, system or process. The use of metrics is so significant, many quality theorists have regarded them as dominant in influencing individual and organisational behaviour. This is for better and worse. Metrics-based systems for improvement of organisations' performance are widely regarded to be problematic (see, for example, Deming, 1986).

Information systems have motivational roles that derive from their use in business strategies intended to create performance improvement. The design of motivational performance improvement strategies is built on a raft of assumptions. One key assumption of many organisational performance improvement strategies is that their processes are continuous. This assumption is problematic in real world situations where discontinuities abound.

The hypothesis that underpins the analyses in this article is:

'Where information systems for motivating performance improvement assume that organisational processes are continuous AND the relevant business processes are significantly discontinuous THEN the information systems for motivating performance improvement are likely to have a reduced or adverse effect on performance or fail.'

This article uses a case study of research motivation in an anonymous Australian university to explore how motivational performance improvement information systems reduce in their effectiveness or cause negative effects when situations are discontinuous. The case study used in this article is drawn from the university organisational environment. Using a university as a case study is useful in this respect because universities contain a broad representative spectrum of organisational intentions for performance improvement and offer the basis for the findings to be applicable more generally.

The case study focuses on real world information systems in a real but anonymous Australian university. The analyses apply not only within the university sector. They have a generic aspect that suggests they are also likely to apply to any organization that uses metrics and information systems for improvement in performance in situations in which contracts are short, motivational information systems involve feedback loops with delays and situations are discontinuous whilst the motivational information systems assume that processes are uniformly continuous.

Organisational performance improvement is a crucial aspect of organisational management. In anything other than the smallest organisation, organisational improvement requires the collection of metrics to identify the current state of the organization and whether proposed strategies that are designed to improve the organization are effective. These metrics also provide the basis for developing motivational strategies for improvement in performance outcomes by employees and management of the company. In public companies, they also provide a strong systemic feedback loop by which shareholders and potential investors can judge the organization's performance, assess the effectiveness of the current management team. For researchers or organisational systems, they provide a snapshot of the motivational pressures for improvement within the organization at a given time.

The structures of metrics-based information systems provide an operational backdrop to the design of motivational strategies for performance improvements. The structure of the information systems can define or be defined by motivational improvement strategies. For example, the use of customer relationship management systems (CMS) can provide metrics on sales leads and numbers of potential transactions flowing through the different levels of the 'sales funnel'. These can be used to provide motivation targets for (and pressure on) sales and related staff. In more complex organisations, management might identify specific performance indicators and arrange for database programmers to include or derive these metrics in the organisations information systems.

By observing performance improvement strategies and related information systems, managers responsible for developing performance improvement strategies commonly assume that the organization can be represented as a continuous process. From a manager's point of view, they have employees and processes to manage and these, at the gross level, are continuous or change only slowly over time. This article suggests that this perspective presents a significant failing in the development of many performance management initiatives. The analyses of the case study suggest that the design of motivational information systems based on assumptions about continuous relatively steady business processes are counterproductive in the many normal organizational situations that are marked by discontinuities at the employee and level and at the level of interaction with the

external organisational environment. The generic basis of these analyses indicates these findings are likely to apply to information systems in most business arenas.

In terms of Beer's viable systems model (see Fig 1) the paper suggests that discontinuities in the ways that systems 1 interact with the environment and level 4 feedback loop to the environment are significantly compromise organisational performance outcomes if level 3, 4 and 5 managers, in particular those at level 3, devise motivational feedback that assumes processes are continuous where in reality they are discontinuous at the above two regions of interaction. This is particularly significant in systems where there are no algedonic alerting loops and weak system 3 alerting loops or they are ignored: both situations that are common in the case study and many organisations. In control system terms, step changes in input and output signals at system 1 levels are responded to by delayed smoothed signals of management, regulation and technical planning. In control systems terms, this guarantees misalignment in phase and magnitude between behaviour and management response. As a result, this guarantees inefficiencies in system 1 processes that may result either in poor outcomes or in extreme cases negative outcomes, instabilities or chaotic system behaviours. In most cases, a more optimal outcome would occur if system 1 processes (individuals and small groups) were disconnected from the overall organisational management processes, i.e. ran as autonomous units.

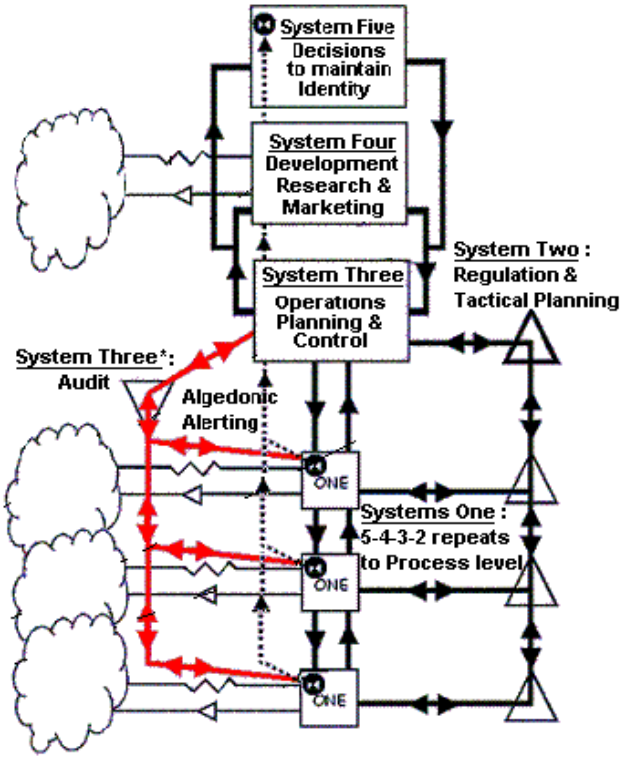

Figure 1: Beerian Viable System Model (Nick Green 25 March 2007 http://en.wikipedia.org/wiki/Image:Vsm.gif) (Beer, 1972)

The above analyses are fleshed out in the case study below to explain and demonstrate these types of systems failures. The case study is of a large complex organization: a university. Universities are interesting because their income is from a variety of different sources that interdepend significantly.

Universities derive their profitable income primarily from a combination of government funding and private tuition fees. The tuition fee stream is mainly from international students. For the case study, these two income streams form around 90% of the university's income. This figure is typical. Government funding is falling

and in Australian universities is now down to around 30% from a situation in which almost all university funding was previously from government grants. The shortfall is now made up by a combination of student fees from fee paying international students and increased teaching efficiencies with concomitant changes to services.

In addition, universities gain income from undertaking research. Typically, this income is less than 10% of a university's income overall although the spending on research is much higher. Research activities commonly run at a loss and are subsidized by income from teaching. Through metrics, however, research has several other roles that positively affect the main income streams via multiple positive feedback loops (see Fig 2 below). Research metrics have a role in the assessment of amounts received of government funding income – including the number of funded research scholarships. The number of satisfactory research training completions also positively feeds back (feedback on feedback) on other incomes. Research metrics also affect the quality of students that the university can attract. This in turn affects student outcomes, which also is a component of positive feedback to increase government funding. This also of course has a direct effect by increasing the attractiveness of the university to privately funded students, mainly from overseas, and the prices that students, and their parents, are willing to pay for their education. Research also has a significant direct marketing role. Universities use descriptions of research projects as promotional material to provide potential students with mental images of excitement and dreams of significant contribution to changing the world and potentially getting wealth and status while doing so. To recap, most of a university's income typically comes from teaching and government funding. Research is usually undertaken at a loss. Research metrics, however, have very significant positive feedback effects on the main income streams.

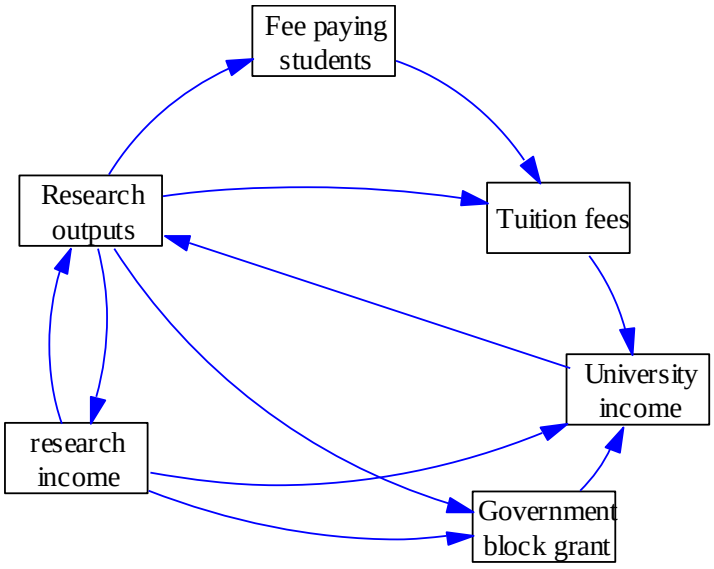

Figure 2: Causal loop diagram of information-driven feedback loops by which research metrics influence teaching income and government funding.

The above issues shape universities motivational strategies for performance improvement and define the information systems that are the means by which these performance improvement strategies are actualized. Universities as organisations, therefore, must develop systems to motivate staff to:

- Improve their teaching performance and effectiveness
- Increase the university's attractiveness to external fee-paying students

- Increase their research output and their efforts to attract external research funding

In practical terms, these motivational performance improvement strategies depend on two classes of practical information systems:

1. Information systems to manage metrics by which performance is assessed
2. Information systems that manage the distribution of resources to encourage staff to achieve performance targets by metering out resources that staff can use to improve their performance outcomes. This latter can also include promotion and the additional resources that go with it.

Similar motivational situations are found in all large organisations that involve a combination of everyday production of products and services along with a new product/service development function that looks to the future. The generic aspects of the analyses developed in the case study below apply to these other large scale organisational contexts. They also, in a simplified form, apply to any organization that uses information systems-based metrics for improving its performance outcomes.

This article has five parts. Following this introduction is a brief review of the case study. The third section of the article teases out the details of specific information systems, processes and structures used for motivation performance improvement in the case study. Section four draws these findings together into generic models of how motivational performance improvement information systems fail when there is a contradiction between their assumptions about smooth continuity and the reality of frequent system discontinuities. The fifth and concluding section outlines strategies to reduce or minimise the negative effects of such systems.

Case study

A case study provides a concrete example by which the underlying principles and analyses of the hypothesis presented in the article can be derived and explained. The case study is of a suite of motivationally utilized information systems and related performance improvement strategies in an anonymous Australian University. The university is typical of the middle-band of universities worldwide with a mixed portfolio of research and teaching. It has aspirations to become a member of the group of universities that are well-known for their research activity

The university's primary income streams, typical of this band of universities and as outlined in the introduction, are from a combination of payments for tuition and assessment, mainly from international students and government grants. Both of these income streams are strongly influenced by research performance within the university. Metrics play a significant role in indicating the amount and quality of research. Key research metrics are research income, research publications, and number of successful and timely student completions of research training in doctoral and Masters by research programs. Research income itself, however, in direct financial terms, is relatively insignificant. Research typically runs at a loss overall requiring subsidy from the other sources of university funding with research income typically less than 5% of overall university income. Subsidizing research activity is, however, an effective strategy because of the leverage that research metrics have on increasing the other sources of university funding.

The performance improvement strategies and information systems include most of the above list of subsidies from non-research funding sources plus from government funding to support research,

Information systems strategies for improving research performance

This case study focuses on the information systems and motivational strategies aimed at performance improvement of research outcomes. Strategies include:

- A research performance index by which staff are paid a sum of money available for their use in undertaking research subject to tight controls. The sum of money they receive each year is based on previous research performance – either previous year or average over 2 or more years.
- Internal competitive research funding – usually this parallels the conditions for research funding from the Australian Research Council and is intended to provide researchers with a training experience of submitting research applications and undertaking research similar to that under the national competitive grant schemes, but softer in its criteria for eligibility.
- Research fellowships that provide multi-year (typically 3-5 years) financial support for recently completed doctoral students who have potential for high research outcomes. This comprises salary for mostly research and a small proportion of teaching and includes some research funding, access to research performance index funding and often has the promise of ongoing employment and promotion at the conclusion of the research fellowship.
- Performance management reviews that can allocate Faculty funding to researchers in a position to increase output over the next performance management period.
- Ad-hoc financial arrangements by which Faculty or University management 'buy out' teaching commitments of teaching staff deemed to have potential for increasing research metrics.

The strategies described above are specific to the case study. They are, however, typical of middle band universities.

Motivational mechanisms

The opportunities for positive motivation of research are strongly shaped by the ways research is subsidized due to the benefits this offers for improving the university's major income streams. Access to some research subsidies is routine. Others are competitive. All research subsidies offer the potential of being used as carrots to encourage researchers to put in extra work to compete for additional resources.

Practical research subsidy methods used at the case study university include:

- Payment from central reserves for a proportion of time for all staff to undertake research. In the anonymous university on which this case is based, all full-time academic staff are paid 20% of their time during semesters to undertake research, plus research time outside semesters.
- Transfer of a proportion of government block grant funding associated with research to a variety of accounts for support for research via university wide and Faculty.
- Academic staff on teaching programs are funded every three years to undertake 3 months 'study leave' for which research outcomes are expected.
- Academic staff are funded every ten years for a 'long service' sabbatical year for which research outcomes are expected.
- The salaries of research fellows from central reserves are funded with the sole aim of them increasing research metrics.

- Central funding for a centre to manage the university-wide administration of research
- Faculty level funding for faculty centres to manage the faculty-level administration of research
- Central funding for a centre to manage the university-wide administration of research training
- Faculty level funding for faculty centres to manage the faculty-level administration of research training
- Central funding to create research centres and support their administration.
- Partial 'buying out' of research active academic staff members' teaching commitments to improve their research output in ways that maximize research metrics. This may be funded centrally or locally at Faculty level.
- Additional partial funding for academic staff to attend national and international conferences. In the case studied here, typically this is around AU$1000 per staff member per year. Note: this is a contribution. Typical economic costs of attending a national conference are around Au$3000 and international conference, AU$5000.
- Ad-hoc funding support for research activities and research active academic staff from Faculty reserves subject to the personal judgment of the Pro-vice chancellors and Deans.

All these arrangements for motivational performance improvement strategies and subsidization are tightly linked with each other and with the information systems by which they are actualized in the university context. They depend on information systems and define information systems requirements. Some examples of the relationships are shown in Table 1 below.

- Faculty level funding for faculty centres to manage the faculty-level administration of research

Table 1: Motivational performance improvement strategies, subsidies and information systems

Motivational strategy	Related subsidy mechanisms	Information systems
research performance index	•	
Internal competitive research funding		
Multi-year research fellowships		
Performance management reviews		
Ad-hoc financial support		

Continuity assumptions

Most arrangements for motivational performance improvement information systems are predicated on or assume unchanging continuity of all relevant factors. In the few exceptions, motivational mechanisms and related information systems comprise discrete conceptual structures that are founded on systems that assume continuity. An example is research fellows. These are limited term arrangements, yet they are tightly integrated with many other systems of motivational performance improvement (such as research funding via research performance index and promotional systems) that are structured on information systems and organisations processes that assume continuity.

There are sound practical reasons for information systems to be built around continuity assumptions. Stability of structure offers a sound basis for maximizing efficiencies and reducing costs. Working with database structures that can dynamically restructure themselves or are frequently modified is generally highly problematic – more so if the databases and information systems concerned are different from and tightly linked to clusters of other, often proprietary, information systems as are typically found in university IS environments.

The soundness or otherwise of the reasons for continuity assumptions in IS design is not, however, the focus. The main concern in this article is about the adverse consequences of these assumptions. These lie in the larger system design arena. The focus is the adverse effects these assumptions of continuity cause in normal organisational situations that includes frequent real-world discontinuities involving real world life changes for individuals such as changes in employment, work status, illness, promotion, change of research focus etc.

Feedback loops and delays

University motivational performance improvement information systems are classic complex socio-technical systems. An important characteristic of all complex socio-technical systems is their feedback loops. Sometimes positive feedback loops tending to increase outputs in line with their own increase and decrease and tend to destabilise the system. Sometimes, there are negative feedback loops whose effect is to change system outputs in the opposite direction to their own increase and decrease and act to stabilise the system. Both positive and negative feedback loops are found in university motivational information systems for performance improvement in this case study. Feedback loops always require a certain amount of time for their effects to be apparent, i.e. effects are delayed and remote in time and often in space from the initiating factors.

Example: Research Performance Index for distributing research funds

An example of a system with such feedback loops is the complex of information and finance systems that provide staff with research funds on the basis of their research outputs.

There are several feedback loops. The two most obvious are:

- The feedback loop that decides on the amount of research funds to be distributed to an individual this year on the basis of their research outputs in previous years.
- The feedback loop that comprises the longer-term effects on future research outputs of the individual using the research funds distributed by the system this year

The motivational effects of the system stem from the carrot of offering increases in future research funds from increased activities undertaken in the present.

Let us look at the system in concrete. In information systems terms, the system comprises multiple information system components that include:

- An internal information system in which academics outputs are recorded
- A financial information system that records how much each academic currently has in their research fund
- An information system that makes the connection between the 'funding available' within the university for research motivation, and the rules for distribution to academics as a whole. Typically, a lump sum is set aside by the university. The total number of research elements is counted across the university, with different weightings per type of element, and the amount of research funding per element is fixed by distributing the total budget available evenly across the weighted research elements. Thus, if the previous year's output is high then for the year following it, the distribution of funding for those elements of the previous year is lower per element if the funding is fixed. In effect, each research being asked to compete for their place in a pecking order for a fixed resource. Where there is an increase in researchers, then the overall payment per research falls.
- An information system for calculating the amount transferred from central financial reserves into each individual researcher's account on the basis of the researcher's previous year's research output.
- The internal information system that identifies which purchases of a researcher can be charged against the funds in their research account. This is required by government constraints on the spending of government distributed research funds as well as attempts by university management to direct academic research spending
- A system of deriving centrally administered computer-based research funding accounts into local sub-accounts. This information system exists and is managed outside the computerized accounting system.
- An information system that refunds the cost of purchases that researchers have made from their own money. This system draws income from the researchers' own research accounts and other general university accounts, for example, ad-hoc or competitive funding for support for conference attendance.

In each case, there are feedback loops that involve individuals, along with computerized and non-computerized metrics and computerized metrics intended to motivate performance improvement and these feedback loops are associated with significant delays and discontinuities.

Classic problems with discontinuous motivational information systems

The case study revealed three classic groupings of problems of motivational information systems in discontinuous situations. Most problems in these areas are overlooked by those developing motivational performance information systems and strategies where the underlying processes are faultily assumed to be continuous. One cluster of problems is at the beginning of a discontinuous process. Another is at the end. In addition, there are groups of problems associated with discontinuities at intermediate points in continuous or discontinuous processes when for example

intermediate assessments, either by metrics or by some other review processes are undertaken with the same motivational intent.

The types of problems described in this section apply in a generic way to all types of systems in which feedback that has a delay is used as part of motivational pressure either via rewards or penalties, and where the system is presumed, perhaps as a simplifying assumption, to be continuous. In the following subsections, the problem will be described first conceptually, and then a brief concrete explanation will be given using an example drawn from the case study.

Problems at the start of a discontinuous process

The start of any process is by its nature a point of discontinuity. There are three different but related sets of initial conditions at the start of an organisational process involving an individual in case study or similar contexts. One set is in the personal realm and relates to the state of the individual themselves relative to the organisation they are embarking on an activity with. The second set is in the conceptual realm and comprises the state of metrics allocated to that individual by an external agency (such as the organisation they are embarking with). This set of initial conditions of a person involved in a discontinuity can perhaps be most usefully conceptualised in terms of the differences relative to someone in a similar position but operating in an infinitely continuing state rather than traversing a discontinuity. The third set comprises the values at the starting point recorded in an information system that represents the metrics and related variables referring to the individual traversing the discontinuity and before they reach a quasi-continuing state. This latter set of initial conditions is commonly recorded in a computerized information system but in terms of the analyses presented here need not necessarily be so. The defining characteristics are that delays are possible between this system and other systems and real-world states.

There are feedback loops and delays associated with the interrelationships between all three of these systems. For example, an individual just starting with a university will from the start increase their metrics relating to experience with the organisation, increases in research performance and other measures that occur naturally over time will however be delayed. All of these factors may, however, be only officially brought to account in metrics terms at a single point in time in the year, such as at the time of a performance review with a manager. There is a lag between the initial starting point of the individual's employment and the date of the performance review. In addition, there is a lag between the establishment of the values of the performance metrics of the individual and the time that these are codified into computerized information systems that form the basis for university processes for motivation via for example distribution of research funding. That is, there is an additional gap, a further feedback lag, between the paper information system of the feedback review and the computer-based information systems. A fourth delay occurs as a result of the time that is needed by university administrative decision making and information system processes to convert the feedback metrics as encapsulated on the computer systems into accessible resources available to the academic. A fifth delay occurs between the time that the academic has access to the resources and the point at which they can use those resources., These latter two delays may be quite significant in that there may be a gap of 3-6 months between he time the metrics reach the computerized information systems and the university making available the funding. After the funding is released, it may be some time before the academic can effectively use the money. For example, it may take time to establish a research project, employ a research assistant, collect data and identify findings, write the project up and submit them as a paper to a journal or a conference. Whilst this is difficult to estimate, typical figures for lags are around 6 months. The sixth delay occurs in closing the loop,

between the time the academic has used research funds and before the outcomes of the research appear as outcomes that can trigger metrics and start the processes again. For example, although the research may be completed and outputs submitted to a journal, it may be a further year before the journal publishes the information. The latter delay is particularly important in a discontinuous situation because for this kind of metric it requires that the material is marked with the affiliation of the employee, i.e. which university they are employed. In a discontinuous situation such as the academic changing university, motivational action closing the loop will not occur because the affiliation and employment will not align.

These initialization problems of delays are significant when the values to which they relate involve motivational access to resources, and are even more significant, where they are part of multi-year processes of feedback relating to assessments of an individual's performance and motivation intended to encourage improved performance.

A concrete example is where academics are provided with research funds on the basis of their previous research performance. In Australia, this is usually done using metrics derived based on the Dept of Education Science and Training's measures of institutional research performance. The metrics include refereed journal articles, refereed conference papers, book chapters, books, research income, and timely research training completions (PhDs and MPhils). The assessment occurs once a year around March. Some universities average an academics performance over two years of these metrics typically using a points system by which each of the two years contributes half the points of assessment of that individual.

This system can be represented as a loop using systems dynamic modeling using delays (see Fig 3 below).

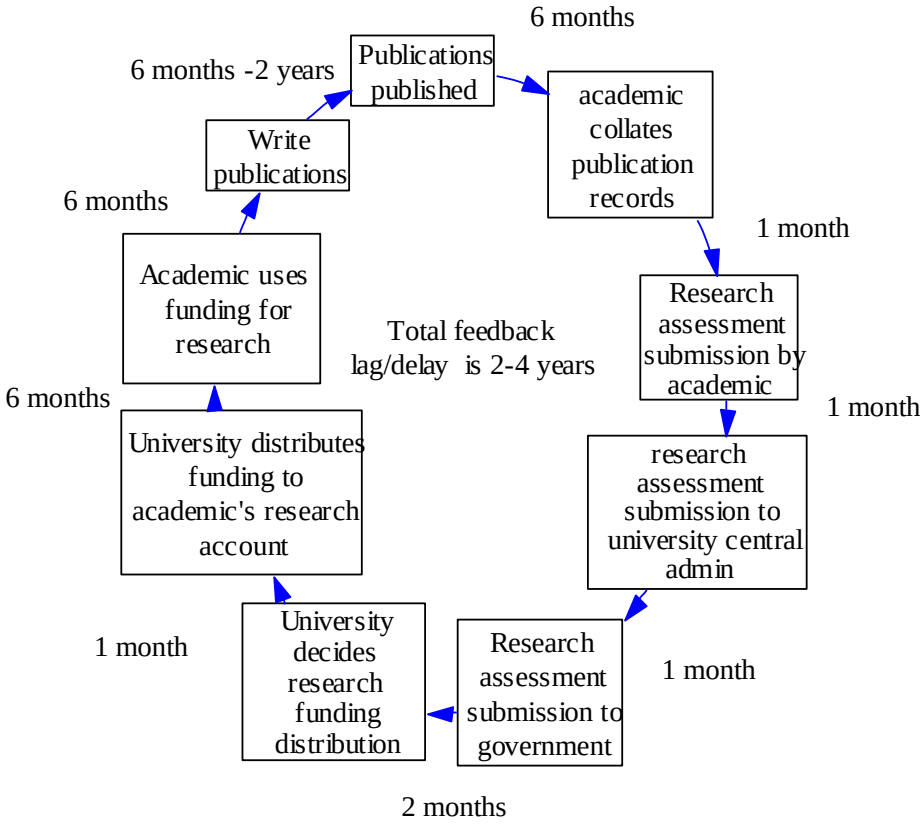

Figure 3: System dynamic model of the feedback loop of motivation and delays for research resource feedback on basis of past performance

Overall, the delays can typically amount to around two years. Delays in the 'motivational' process can amount to considerably more than two years in the case study situation in which:

- the university uses metric averaging across two years
- where money is not made available quickly for academics
- where academics are not in a position to use their research funds (for example where they have heavy teaching commitments)
- academics work in areas in which publication rates are slow (i.e. journals take a long time between submission and the time of publications)
- the starting point of the individual's employment is at a significant phase angle to the trigger points of metrics, then the.

The outcome is that for two years or more, the motivational effect of the information systems intended to encourage performance improvement are zero or negative in that motivationally the employee is being asked to commit on trust to a significant workload with only the long-term promise of a return. Clearly, the motivational potential of this situation is only possible with individuals who are comfortable with extremely deferred gratification.

In the case of relatively short-term staff with contracts for three years or less, the end effects of discontinuities destroy motivational effects for all three years of employment.

The employee is better to have a stable adjunct position elsewhere, preferably one that offers high motivational access to resources, and allocate their publications and research outputs there rather than at the institution to which they are employed.

Anti-motivational effects from delays

When an experienced academic transfers between universities, the time of transfer is not usually aligned with the timelines of research projects. Typically, academics arrive at a new job with research projects in partially completed states, started during their previous employment. In the unusual situation in which a researcher has completed all projects, new projects to start and transferred to the new institution, this presents other problems associated with delays in establishing project as sketched in the previous section.

Motivationally, if an academic arrives at a new institution with half completed research projects it is important that the project support is better than at the previous institution. The case study indicated, however, that there is a significant delay in access to research resources and initially, at least, a lower quality of access to research resources, along with a considerable amount of extra work in addressing problems due to information system delays. There are delays at the discontinuity from a wide range of information system related factors such as transferring data onto different systems, obtaining legitimate access to systems, obtaining the resources for rebuilding the academic's working environment in the new context, establishing new paperwork, learning the research management processes of the new institution.

The university that is the subject of this case study has comprehensive and extensive bureaucratic systems (contrary to the advice of Deming) that are complex and siloed. That is, a highly interlinked bureaucracy is distributed between across 'whole of university's systems and highly independent local systems. Delays in providing services to new academics are high as is the administrative load on the academic. The upshot delays in ongoing research projects, along with a negative motivational

effect on the academic from the increased effort in undertaking research projects and a negative comparison between the previous system and systems at the new institution.

The motivational system that provides internal research funds for staff based on their performances provides resources that an academic can use as a seed fund for undertaking interesting analyses or attending conferences etc. Building this 'seed fund' takes time as it comprises savings from multiple research projects together with the residue of annual funding from research performance motivational resources. A staff member arriving at a new university arrives divested in the record of activity and the 'seed' research funding allocated at their previous employment. This internal 'seed' research funding is important because it usually provides for the everyday, non-specific research costs of a research active academic. This includes funds funding speculative exploratory research, travel to meetings, conferencing, etc that builds the groundwork and network basis for new research projects and new collaborative funding applications. Typical funds are in the order of $5,000 to $50,000. Employment discontinuity results in a loss of seed funding (and the important micro-infrastructure research support it offers) because of a lack of integration across the information systems of the institutions before and after the employment change and because of assumptions about continuity in existing systems. It results in a subsequent slow start to new research projects and a reduction in motivation (and of course, a financial gain for the previous employer).

Academics are increasing using adjunct arrangements with a prior employer to enable them to access research funds generated with that employer as an appropriate way to respond to universities complications in ongoing information systems that do not adequately address discontinuous situations. Adjunct arrangements have potential positive effects, in that they enable academics to have more extensive research networks across institutions because they are effectively members of more than one institution. The arrangement, however, offers anti-motivational effects that act against the motivational strategies of the new employer and potentially tend to dilute the attempts of encouraging performance improvement, in part by increasing overheads and in part by the employee having distributed loyalties.

Adverse performance motivation effects at the conclusion of employment

Failure of motivational information systems to address discontinuity issues adversely affect individuals' motivation and results in reduced performance at or near conclusion of employment. These adverse effects are in addition to any factors that have perhaps led an individual to change employment.

Performance is impacted adversely by many aspects of the failure of motivational information systems and strategies to address discontinuity issues. Most result from common causes in systems process. Some originate in behaviours of other staff, general and academic. Some originate in the changes in the behaviour of the individual at the centre of the discontinuity. By observation, the most dominant are the adverse effects caused by the influence of the failure of motivational systems and strategies to address discontinuities well and encourage reduced performance outcomes. A particular focus of effects clusters around the failure of motivational information systems to manage access to research resources in ways that maintain motivation. To remind, most typical approaches have access to research resources and research funds (for the future) tied by means of rules and system structures to

research performance in the past in ways that have substantial lags and delays in the feedback and feed forward loops. These delays are typically of the order of one to two years and in many circumstances are up to five years.

A key issue is that of affiliation whereby research and publications are identified by the author as an affiliation with a particular institution. Access to motivational research funds depends on the number of research outcomes of the individual with the affiliation in the documentation of the research outputs aligning with the institution providing the motivational resources.

To avoid or minimize individual academics' discontinuities in access to institutionally provided motivational research resources and the associated negative effects on individual academics' personal research profile, individuals must choose to allocate their affiliations strategically at a time of discontinuity of employment. Thus, optimal behaviour for an individual thinking of transferring their employment to a different institution is to consider how they will manage their affiliation of their research outcomes in the 2 or so years prior to the move. In Deming's terms, this is a generic *common cause* problem for all staff on contracts for 3 years or less. That is, response to it is a matter for improved management of systems by university management, rather than something that is the responsibility of individuals subject to the system.

In many cases, for academics, transfer to a new institution is delayed by the long periods of notice that must be given of typically a semester or more. Affiliation attribution of research outputs during this time clearly presents a difficult issue because the academic is committed to moving to a new institution and allocation affiliation of their work to the current institution has no potential for recovering the associated research resource associated with those outputs, because of the delays in the information systems' feedback loops. The outcome is a strongly reduced motivational effect on the individual on their work performance at both the current institution and the future institution.

Many aspects of the end of contract situation for research academics are such that academics of necessity are aware of moving to another employer long before the date of the move. In many cases, academics whose life involves research have decided to look for a move one or two years before undertaking it. This is in part driven by the pressures due to the disfunctionality of the motivational information systems that allocate resources on the basis of research performance. These end effects also adversely affect conventional performance management systems such as those involving annual management by performance review session between employees and their immediate line managers. In their ideal form, management for performance reviews comprises a meeting whereby the previous year's performance of an employee is compared against agreed targets for that employee and new targets are set. In some cases, this performance review is also tied to salary bonuses and the allocation of resources. For researchers who have decided to move on, the motivational and performance aspects of the performance management review become effectively redundant because the motivational benefits or threats will occur after the employee has left.

A similar situation, but in a longer wave form, occurs in respect to promotions. Promotion processes assume that academic researchers will have continuous and ongoing employment with the institution in question. Promotion is used as a tempter and motivator for performance improvement. Increments between promotion points offer a limited number of steps with a ceiling hence performance improvement resulting in promotion offers a way of breaking through the increment ceiling to continue with increased income returns. This motivational information system is only effective in situations in which an employee is employed long enough to reach the ceiling of increments or is in a situation in which their research and other work

performance is such that they are close to being eligible for promotion. The situation is also compromised, however, because of the long timeline of promotion processes. Typically, in the case of the case study institution, gathering information and undertaking the promotion process takes at least a year. It takes one year if the candidate is successful and has a three-year cycle if the promotion is unsuccessful because in the case concerned, the candidate is ineligible to apply for promotion in the year following the year that a promotion application is rejected. In addition, the end effects of promotion, i.e. the time taken to prepare promotion material (also an information system issue), also adversely impacts on the time and resources of the academic that would otherwise be used to create the research and related outputs that would support their promotion this adds a further delay – reducing motivation further.

Adverse performance motivation effects due to mid-term discontinuities

Promotional processes as described above are also examples of mid-term discontinuities, whose management via motivational performance improvement information systems leads to adverse effects on academic performance and motivation for the reasons described. Again, in theoretical terms, reduced or negative motivational effects result from the in-place motivational performance imperilment information systems because of their failure to address discontinuities. Typically, the problems result from delays separating motivational carrots from the donkeywork and resulting in the work component being institutionally disconnected from the promise of future carrots. Or alternatively and perhaps worse, that the individual academic is required to improve performance using systems defined by the management of the institution that make it impossible. This is a situation in which university management is confusing *common causes* and *special causes* of quality (Deming, 1986).

A practical example, particularly relevant to research fellow programs, is that of mid-term review. Research Fellow programs are those in which new research fellows are employed on a relatively long contract 4-5 years to conduct some research of significance with the aim of them becoming part of the area of scholarship on completion of this contract. In essence, research fellow programs have three aims. This first is for a university to have affiliated to them researchers at typically the most productive time of their careers. The second is to provide additional research support or strength for existing research centres, particularly where the research fellow offers strength in new perspectives or new theoretical or data gathering and analysis approaches. The third, and in terms of overall performance improvement, most significant, is to build research capacity with researchers who are at the cutting edge of knowledge, because they have only recently completed their PhDs. The latter in essence is also a mechanism to bring ‘new blood’ both in thinking and in youthful years, into the university’s organisations. It is common for there to be a variety of intermediate reviews of research fellow work. One reason for this is to identify whether the research fellow is remaining on track as expected. Another reason, which is related more to the teaching program in the area of scholarship, is to review the candidates as to whether they would be suitable for ongoing employment. The case study that is the basis of this article uses a combination of annual reviews with an intermediate deep review at three years through a 5-year research fellowship. The new research fellow is issued initially with a three year contract (although with promise that with satisfactory performance, this continues to five years and then ongoing employment with immediate promotion to senior lecturer on completion of the five year term) for salary plus a small amount of research funding tied to the

project that is central to the fellowship. After the three years, and subject to satisfactory review, the candidate is provided with a further 2-year contract and salary with 50% of their time spent on teaching (as a lecturer or in supervision). The contract contains the expectation of ongoing employment and promotion at the end of the five-year period. Promotion is of significance because at the end of the five-year period, the research fellow will no longer get annual salary increments because they will have reached the top of the increment scale.

From the research fellow's personal viewpoint, each stage of intermediate review is marked by many of the problems of both the discontinuities of conclusion of employment and discontinuities of starting employment. In the time prior to intermediate review, the research fellow has to decide what is best to do to maximise outcomes. The most obvious strategy is to spend all their research resources (research seed funds etc) and to develop but not publish papers, to publish only poorer quality papers (i.e. to fulfill the metrics at the expense of quality) or, where the opportunity is available, to hedge and publish under a variety of affiliations. The emotional effect of motivational information systems and strategies is negative and results in loss of loyalty towards the employing institution.

Adverse performance motivation effects due to systemic discontinuities

In the case study it was evident that the design of performance management strategies and related motivational information systems were shaped primarily by the university management's enthusiasm for 'cost-centering' and the establishment of silos. The implementation of cost-centering and silo-ing, particularly when they are co-located as in the case study, result in the formation of relatively autonomous sub-organisations. The university and its systems become spatially discontinuous as well as temporarily discontinuous. Similar problems of adverse motivation effects arise in relation to spatial discontinuities. In systems terms, there emerge a raft of problems that result from the failures of operation of whole of university systems that disintegrate at the boundaries of the silos. Siloing results in a drive for the silos to achieve *local suboptimisation* whereby local elements of the organisation try to maximize their performance regardless of adverse affects on the performance of other organisational units or adverse affects on the organisation as a whole or on the organisational, social and environmental eco-systems of which it is a part. It results in a bevy of unsustainable practices and drives the organisation in the opposite direction from any sustainability agendas it might propose. Similarly, for cost centered sub-organisations, maximizing benefits for the cost centre override university-wide financial or operational considerations. In system organisational terms, 'siloing' though individual management creates a raft of 'whole of organisation' problems and problems for the wider environment in part because it disconnects siloed departments from levels 4 and 5 in Beers Viable Systems hierarchy. It presents one of the classic cases of organisational pathology.

Systemic practices and systems design at university level drive the formation of these discontinuities. For example, the funding for research is typically managed by a separate department of research and development, whereas teaching and the normal activities of the university that generate the two major income streams are located in departments typically classified under discipline or subject grounds. Research-related funding from the department of research and development is distributed to and managed by the discipline-based departments and their management structure because, typically, line management of staff occurs through these structures. This provides the basis for a heavily siloed organisation, particularly

if performance and costs of siloed units are assessed in terms of cost centres and if siloed units are made to compete against each other for resources.

Another form of systemic discontinuity occurs when an information system has a self-referential feedback loop with a delay. Such a system with an internal lockstep feedback control can constrain the effectiveness of performance improvement strategies and motivational information systems elsewhere. One example from the case study is the systemic effects of distributing research funding evenly based on current research levels with the overall amount being distributed being derived from. previous years. That is if 100 items of research output last year resulted in $1000 research income this year and that was distributed over 100 items of research output this year, it results in $10 per item of research output. This is effective if the situation is unchanging. It has anti-motivational effects in the discontinuous or highly varying situation typical of university research.

A year of good research metrics after a year of poor research outcomes results in significantly less funding to departments and individual researchers per item of research. The year of poor research outcomes and metrics results in a reduced level of assets for the department of research and development to distribute the following year. The natural variation between years means that in years of high research output, the individual rewards for contributions is significantly diminished because the pot of money available is reduced by the previous low year, and is distributed across a larger number of outcomes – doubling the reduction – and this reduces motivation for research as the pool of staff undertaking research increases. In contrast, a low output year after a good output year will result in the few staff that have stayed involved in research and created research outputs gaining a much higher payout per item and thus much more motivation. By observation, the combination of these effects is to encourage the establishment of a relatively fixed small clique of researchers.

Conclusions

Motivational information systems for performance improvement produce reduced or negative effects due to their failure to address discontinuities in time and space. These discontinuities are common in the everyday real world of universities and similar organisations.

In systems terms, the problems of failure of motivation for performance improvement are due to:

- slow feedback due to poorly designed or administered university systems with significant delays in their feedback loops and system processes
- feedback loops on which motivation offerings depends fail or are delayed by temporal discontinuities (employment, reviews, publishing)
- failure by management to understand the difference between common cause and special cause reasons for quality and failure to address common cause reasons and manage in terms of statistical control
- systemic conflicts at the discontinuities between whole of organisation systems and relatively autonomous cost-centred silos resulting in the adverse effects of local suboptimisation.

As mentioned earlier, academics are developing effective strategies to improve their outcomes at discontinuities in the face of the failure of motivational performance improvement information systems. These strategies typically give advantages to academics at the expense of the institution.

A parallel research project has identified eight information systems design strategies to address the problems reported in this article. These will be the subject of a future paper.

In summary, this article reported on analysis of a case study focused on the problems of motivational information systems and performance improvement strategies at discontinuities. The case study comprised of a middle-range university. The analyses identified a wide range of issues and causes, primarily due to feedback loops. The generic nature of the analyses would be expected to apply more generally to medium large organisations that use motivational performance improvement systems that draw on metrics codified in information systems. Improvements to system design have been identified and will be reported in a later paper.

References

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