Position paper on theory in through life management

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Abstract

The objective of this position paper is to review, from a theoretical point of view, the practice of and research on through life management. It is argued that the rationale of TLM is elusive and its theoretical basis insufficient. Regarding information systems for through life management, an approach based on ethnomethodology is provided. Regarding learning from use, the embedded nature of effective learning is discussed. Regarding governance and management, the common denial to acknowledge production as a fundamental ingredient in TLM is considered. It is concluded that through life management is an under theorized domain, and further progress requires increased research efforts.

1. Introduction

Three issues deserve to be stated at the outset. First, theory is important, both for research and practice. Secondly, theory comes in many forms, depending on the object and approach of the inquiry. Both issues have recently been treated elsewhere (Koskela 2008). Thirdly, this position paper is heavily influenced by the personal research programmes of the two senior authors. Koskela's research programme on design and production is described in Appendix 1. Rooke's research programme has focused on adequate methods to study human organisation (Seymour & Rooke 1995; Rooke & Seymour 2005; Rooke & Kagioglou 2007).

This position paper consists of two parts. First, we comment the status of the theory in through life management in general. Second, we comment on the generic research issues deriving from the three work packages in the KIM project.

2. What is the theory of through life management?

Similarly to many other managerial innovations, through life management has been predominantly originated by practitioners rather than by academics. Thus, academic theory oriented research may aim at constructing the underlying theory that will give the considered management model its universal value, or to clarify, further develop, test or extend the theory that gives the model its universal value (David & Hatchuel 2007). Perhaps less frequently, academic research aims at creating new theories and managerial models based on them.

Through life management, understood as a trend towards a careful consideration of the whole life-cycle of a product or facility, is an umbrella term covering several current approaches: life-cycle assessment, product-service systems, product life-cycle

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management, systems engineering, integrated solutions, public-private partnerships, and concurrent engineering. It has been concluded that there is a great variety of rationales, arguments and mechanisms involved in approaches relating to realizing products and services over time (Koskela & al. 2007).

However, at the core of through life management is the issue of managing design and production of artefacts and related services. The starting point for any discussion on through-life management is the traditional way of product realization, where the focus is on the situation of the handover of the product to its user. The conceptual approaches towards through life management, as identified in (Koskela, Siriwardena & Rooke 2008), are characterized by an attempt to augment and extend that model (Table 1).

Figure 1: Conceptual approaches to through-life management

- From investment cost to life cycle costs – from minimization of investments costs to minimization of life cycle costs of the artefact under design and construction, the specifications of the artefact being given
- From cost to value - it is not enough to look at the costs, but also the value provided by the artefact should be taken into account
- From design focus to life cycle focus - from optimization in design to dynamic optimization during the whole life cycle
- From black box to open box understanding of production – from understanding of production as a black box to active use of production theories and concepts
- From static analysis to dynamic analysis – from a static view of managing the design and production to a dynamic view (where learning and improvement is fostered; continuous focus of waste elimination and value maximisation)
- From flows to capitals – from looking narrowly at the flows of value and costs to a broader view that acknowledges the need to preserve and increase associated capitals
- From understanding of management as decision making to a design approach – from looking narrowly on decisions to embracing the broader view of management as design

It is safe to say that although there are several approaches and techniques such as life cycle costing, whole life value, life cycle assessment, there isn't a unified view of what is meant by through-life management in practice. In most cases, theoretical foundation is missing or weak.

Thus, there are fruitful opportunities to do theory-oriented research. For example, regarding the shift from investment costs to life-cycle costs, Pelzeter (2007) provides a critical analysis on the current modelling methods. Regarding the shift from design focus to life cycle focus, Antonacopoulou and Konstantinou (2008) critically review the underlying key principles of "the new service model". In contrast, the theoretical framework created by Pearce (2003) towards taking capitals as the central unit of analysis would obviously need applied research for creating the corresponding managerial models.

Generally it can be stated that theoretical work on through life management has been so scarce that we even struggle to pinpoint the most significant theoretical problems in this field. It must be concluded that this is an under theorized domain, and any progress requires, in the first place, increased research efforts.

3. Critical remarks on theory regarding the KIM research areas

3.1 Information systems (WP1)

Inasmuch as the development of through-life support concerns the development of information systems, its primary concern must be with the way that these systems will be used. The role of theory in such an endeavour requires careful consideration.

Practice may well be based on theory, but the theory on which it is based is the theory to be found in the setting, not the theory that the researcher brings to the setting. If the need is to develop ICT support for engineers, for instance, it is the theory and practice of engineering that is relevant. Other theories, such as management theory, information theory etc. do not account for what the engineers are up to. (Unless of course they have learned these theories also and only then, if they are actually putting them into practice.)

3.2 Researching user practice

When the subsidiary role of theory in this context is understood, the relevance of ethnomethodology (EM) becomes apparent. EM may be defined as the detailed analysis of mundane practices according to the criteria of the unique adequacy (UA) requirement of methods (Garfinkel & Wieder 1974). The UA requirement has two parts. In its weak form, it demands that to analyse a research setting adequately, we must know what any participant in that setting would ordinarily know about it. This knowledge, expressed as competence, is the kind referred to by Ryle (1963) as 'knowing how'; it consists in being able to perform relevant activities within that setting without censure from other members. The question of whether such an understanding has been achieved is a matter for the judgement of any other competent participant.

In this form the requirement is a criterion for adequate ethnography, the most certain method for acquiring such knowledge being participant observation. However, it is possible to usefully apply it to other forms of enquiry, such as interviews and questionnaires. Thus, for instance, a questionnaire designed by someone who has not achieved a UA competence in the setting in which it is to be administered is likely to contain irrelevant, misleading or meaningless questions (Rooke & Kagioglou 2005).

Meeting the weak requirement is a researcher's problem. Any member of the setting (that is anyone having sufficient competence to operate in the setting without censure) is capable of delivering an account of that setting which meets the weak requirement. For a researcher encountering that setting for the first time, it is a matter of achieving this level of competence.

By contrast, the strong requirement concerns the reporting of research. It demands that the methods of analysis used to report on a setting should be derived from that setting. In effect, it stipulates the application of a policy of 'ethnomethodological

indifference': a refusal to evaluate, describe or explain the activities that constitute the setting using criteria, concepts or theories that are not a part of that setting.

This criterion is made both possible and desirable because human organizational settings are constituted using methodological procedures that are sufficient to account for them. The methods that members of a setting use to make their meanings clear to other members of that setting, to create and maintain that setting, to make it work, are necessary and sufficient to the purpose of analysing that setting because they are necessary and sufficient to the constitution of that setting in the first place. Thus, producing a description of that setting is a matter of seeing how that setting is made to work by its members and presenting these methods in the report. Any other methods must involve some distortion of the phenomenon. However, as Lynch (1999) affirms, "indifference is not the same as a value-free or value-neutral posture" (p. 221) it is primarily intended to exclude only value judgements from outside the research context. Such non-indigenous judgements will inevitably be made when the nature of the value judgements that constitute the context of the research are not understood. Hence, it is necessary to achieve the weak requirement, if the strong requirement is to be achieved also.

While the weak requirement demands only a conscientious attitude from researchers, in that they are to employ ordinary common sense methods of enquiry to learn the research setting, the strong requirement calls for the exercise of a specific research practice, ethnomethodological indifference. It requires that researchers learn the skilful exercise of this practice (Lynch 1999).

This kind of research is necessary to the task of determining indigenous ontologies, such that these can be used to design information systems that are uniquely adequate to the functions they are required to perform. Theoretically driven research is inadequate to this task, since theory, by its nature, dictates a selective attention to the details of a research phenomenon. The use of models is also inadequate, since the simplification involved in model building, will necessarily omit detail which may be later found relevant. (To be clear on this last point: a database itself might be viewed as a model ontology, but the uses to which the database may be put are not explicit features of that model. It is not sufficient to know, in the sense of 'knowing that' (Ryle 1963) the ontology in use by say architects, highways engineers, or steel-fixers; it is essential to know how the categories of the ontology are used in practice. It is the extent to which the latter has been achieved that will determine the extent to which the database is usable in practice.

Attention to theory in this kind of research consists in learning the theory that members know and use (and thus, where necessary, being able to specify the theory that is espoused, but not used). It encompasses a knowledge of how and when the theory is used and to what purpose.

3.3 Improving user practice

There is little point in designing information systems that support bad practice. Since it is often the intention, through the introduction of information systems, to improve practice, a different kind of attention to theory is required. This kind of attention is given in the practice of design science, which is distinct from the EM practice described above.

Theory in management, is oriented towards change, it is prescriptive. Thus, it is suited to the task of designing software that will support improved practice. On the

other hand, it is pointless to develop software which supports non-existent practice. The attention here must also be on how practice is to be improved.

So there are three interrelated issues here for theoretical (design) attention: (1) how to design better practice; (2) how to improve practice; (3) how to encourage the optimum use of information systems.

Improving practice requires design, implementation and deployment. TFV (Koskela 2000), the theory of variation (Deming 1986), factory physics (Hopp & Spearman) and principles such as shielding production (Ballard & Howell 1998) are examples of theoretical resources available for the design of better production systems. No doubt there are others and no doubt there is further valuable work to be done. The V element of TFV provides one clear answer to what constitutes improvement? Thus, value is seen in terms of customer satisfaction (and customers, of course, can be identified at every point in the process of design, production and delivery.

It has long been recognised that uni-polar concepts of value are inadequate to the understanding of production (Marx 1976; Durkheim 1933; Weber 1930). Sociology's founding theoretical debates continue to have deep relevance to the question of production today, unfortunately finding only faint echo in the contemporary sociological concerns of post-modernists and structuralists. Nonetheless, the foundational theoretical works of Marx, Weber and Durkheim remain a valuable resource for our studies.

More recently, progress has been made in the integration of lean thinking and the language action perspective (Macomber & Howell 2003; Howell, Macomber, Koskela. & Draper 2004). Here, production projects are viewed as conversations, a potentially powerful metaphor for understanding and effecting organisational order and change.

Work on the PPU-N model at Salford has attempted to account for the multiplicity of stakeholder perspectives throughout the life-cycle of a built environment product, in terms of meta-roles (Siriwardena & al. 2008).

On the other hand, while achieving improvements in practice simultaneously with the implementation of information systems remains an attractive prize, even if information systems have not been designed to support better practice, the problem of optimum use remains.

3.4 Improving information systems design

Whether designing systems for improved or existing practice, requirements capture remains crucial. In this context, theory becomes an obstacle, rather than a useful resource. This is because, as the UA requirement insists, it is the ideas that are operant in the production setting that account for the moment to moment constitution of that setting. Additional theoretical resource is not merely redundant, but can only distort our understanding of the local social mechanics of the organisation.

Ethnography has long been recognised as a powerful resource for the design of ICT, EM studies constitute the purest form of ethnographic practice (Rooke & Seymour 2005). However, as Crabtree (2004) notes, the tendency is to use ethnographic findings simply as resources to the design process. Following Button & Dourish (1996) he suggests a stronger role for EM, the creation of a hybrid discipline of EM informed design. Such a process might have the following features:

“1. Let designers build whatever they want with whomever they want, subject to their own constraints.

2. Deploy the objects of design in real world settings.

3. Treat deployment as a breaching experiment.

4. Explicate the accountable structures of practical action made visible in the breach.

5. Explore the topics identified in the breach through the study of perspicuous settings.

6. Use the studies of perspicuous settings to flesh out abstract design concepts.

7. Deploy the new design solution in real world settings and study its use.

8. Repeat the process until the research agenda has been satisfied for all practical purposes.

3.5 Summary: A new research agenda

Whether or not Crabtree’s suggestions are adopted, the following would seem to be necessary minimum elements for adequate development of information systems that support production

- learn the practice (detailed ethnographic study, preferably to the standard of the UA requirement)
- learn the theory that underpins the practice
- evaluate the theory (does it really underpin the practice, or is it an attempt to formalise an already existing practice, if it's the latter, how well does it do this?)
- plan and implement a change programme to accommodate the necessary changes that accompany the implementation of the ICT (involving theoretical knowledge of organisational change management).

In addition, these elements seem to be necessary to support production process improvement:

- learn the theory that attempts to account for the practice
- learn the current theoretical debates in the field
- evaluate the debate, in order to anticipate advances in practice
- decide between current and improved practice (change always carries a cost)
- where improved practice is chosen over current practice, plan and implement an improvement programme as part of a the wider change programme.

All this is, of course, in addition to the theoretical resources that guide the technical aspects of information systems development.

4 Learning from use (WP2)

4.1 Knowledge management systems

However, to discuss knowledge and information management as though it consisted entirely of information management is misleading. As KIM has recognised from the

outset, knowledge cannot be reduced to information. Notwithstanding some lack of clarity in the definitional work on which KIM is based (Davenport & Prusak 1997; Rooke, Siriwardena & Koskela 2008), the communities of practice conception highlights the important social and practical aspects of knowledge (Wenger 1999), echoing earlier insights of ethnomethodology (Garfinkel 1984; Heritage 1984).

However, we would suggest that the communities of practice concept is likely to prove too narrow a theoretical basis for either of these endeavours, notwithstanding its vital contribution in stressing the social and pragmatic nature of knowledge. What is needed is a comprehensive understanding of knowledge as a thoroughgoing social phenomenon, such as that provided by writers such as Wittgenstein and Garfinkel. It is through pursuing the insights of these thinkers that we have developed, on the one hand, the tri-partite conception of knowledge: artefact, information, practice (Rooke, Siriwardena & Koskela 2008).

On the other hand, what is lacking is a broader approach, which encompasses not only learning from use, but also learning for use. In other words, learning needs to be seen in the broader context of the problems of organisational knowledge and change.

A realistic conception of a knowledge management system needs to address all the various ways in which the organisation acquires, retains and disseminates knowledge, in all its forms; not just as information stored in ICT systems. In particular, we suggest, learning theory ought to be addressed.

4.2 Learning theory

A basic model of learning used by quality managers is the plan-do-check-act (PDCA) cycle, representing a simplification of the model offered by Deming (1986), who in turn derived it from Shewhart's (Shewhart & Deming 1939) theoretical work:

"1. What could be the most important accomplishments of this team? What changes might be desirable? What data are available? Are new observations needed? If yes, plan a change or test. Decide how to use the observations.

2. Carry out the change or test decided upon, preferably on a small scale.

3. Observe the effects of the change or test.

4. Study the results. What did we learn? What can we predict.

Step 5. Repeat Step 1, with knowledge accumulated.

Step 6. Repeat Step 2, and onward." (Deming 1986, p88)

This is widely known as the Deming cycle, though Deming himself attributes it to Shewhart.

It is worthwhile to look at the original formulations of Shewhart (Shewhart & Deming 1939): "It may be helpful to think of the three steps in the mass production process as steps in the scientific method. In this sense, specification, production, and inspection correspond respectively to making a hypothesis, carrying out an experiment, and testing the hypothesis. These three steps constitute a dynamic scientific process of acquiring knowledge." And further: "Mass production viewed in this way constitutes a continuing and self-corrective method for making the most effective use of raw and fabricated materials."

It is clearly a learning cycle that is being described. This may be compared to a more commonly known learning cycle described by Kölb (1984) as part of his theory of

active learning. The following equivalencies become apparent (the terms following the = sign, are derived from Kölb):

1. Plan = abstract conceptualisation;
2. Do = active experimentation;
3. Check = concrete experience (monitoring)
4. Act = reflective observation (study the results, feed lessons back into Step 1)

While this correspondence is a promising insight into the possibility of reconciling the two learning theories, there is a crucial difference between these. Kölb's theory addresses learning embodied in a human being, whereas Shewhart's theory looks at learning embodied in a production system. Now, Shewhart's theory is widely used not only in quality contexts, but also in the Toyota Production System. Spear (2002) found that in the Toyota Production System, there are embedded tests in the work-systems to build process knowledge and capability.

What does this imply? Learning can not be studied solely as an independent individual or social phenomenon – as generally assumed in social and managerial sciences - but rather as an integral part of production. From the point of through life management, surely the setting where learning is an integral part of production is most important - and the problem of preserving that learning through life arises.

5 Management and governance (WP3)

Through life management is essentially about managing production (first facility and then service). Regarding management and governance of through life management settings, our concern is in the use of organizational theory that has abstracted production away. As leading organizational theorists are ready to admit, organizational theory has avoided the phenomena of work[2] or materiality[3], both issues belonging to production. Mainstream (and also fringe) organization theory and management science namely overlook one significant explaining factor for organization and management system design: how production is conceptualized and theorized[4]. However, in fact, conceptual innovations regarding production have deeply influenced and changed organizational and management practice:

- Production as transformation: mainstream doctrine on management
- Production as flow: Toyota Production System
- Production as value generation: Total Quality Management

[2] "…we argue that organization theory's effort to make sense of post-bureaucratic organizing is hampered by a dearth of detailed studies of work. We review the history of organization theory to show that in the past, studies of work provided an empirical foundation for theories of bureaucracy, and explain how such research became marginalized or ignored." (Barley & Kunda 2001). However, it has to be noted that work does not exhaust the phenomenon of production. Work is about what people do to objects of work. Production is also about what happens to objects of work in production and about what happens to the cause of production: customer voice.

[3] "Over the years, the field of organization studies has generated important and valuable insights into the cultural, institutional, and situated aspects of organizing. However, I want to argue that these insights are limited in large part because the field has traditionally overlooked the ways in which organizing is bound up with the material forms and spaces through which humans act and interact." (Orlikowski 2007). Of course, these material forms and spaces are affected by the available technology, but also by the concepts of production.

[4] Note that this is different from the well-known arguments on nature of technology, changes in work or transaction costs as explaining factors for organizing.

This can be justified by observing how such industrial templates have been formed around seminal concepts of production (Koskela 2000). On the other hand, organization theory has not been able to explain the emergence of new organizational and managerial modes in connection to Total Quality Management and derivatives as well as Lean Production.

5.1 Does changed structure provide the intended benefits?

One common fallacy deriving from the neglect of production in organizational and management studies is the assumption that a changed organizational structure will produce targeted outcomes (Koskela 2003). In the domain of through life management, an example of this fallacy is the idea that a single point of responsibility over the life time of a facility will compel to use through life management.

However, seen from a production viewpoint, a structural solution will only, if at all, affect the design of the production system. The two other significant aspects of production, namely operation and improvement of the production system, are not directly affected – there are no automatic mechanisms. Unfortunately, the purported benefits of a structural solution can easily be wiped off by unchanged and/or problematic solutions at the level of operation and improvement. This was dramatically illustrated in the research by Rintala (2004), aiming to generate a detailed understanding of how the economic efficiency of an accommodation service PFI project is determined in its development process through life cycle cost minimisation. Embarrassingly, not a single whole life cost driven design solution could be identified in the heating and ventilation design solutions of the case study facilities.

The cases of Rintala can not be seen as exceptions. In work underway, the rationale of PPP has been defined as (Koskela, Rooke & Siriwardena, in progress):

> "(1) In creating a single point of responsibility and a long temporal involvement, (2) the public private partnership model provides the effective incentive (3) to implement through-life management."

Empirical evidence shows that actually there are various ways through which these three sub claims of this rationale fail to be realized in PPP projects, with critical impacts on their effectiveness and efficiency.

Thus, the critical task is to take the prescriptions of production theory into account, besides other relevant bodies of theory, when designing the structure, operation and improvement of through life management settings.

6 Conclusions

Through life management, similarly to many other managerial innovations, lacks an explicit and unified theoretical foundation. For achieving real progress in the efficiency of this important approach, its theoretical foundation must be strengthened. Because of the width of this approach, this is an ambitious project, also given the relative immaturity of many underlying disciplines. One of the first tasks is to identify the major theoretical problems inherent in the practical application of through life management.

References

Antonacopoulou, E.P. & Konstantinou, E. (2008) The New Service: a review, a critique and a way forward. The Service Industries Journal, Vol. 28, No. 6, pp. 845-860.

Ballard, G. & Howell, G. (1998) 'Shielding Production: Essential Step in Production Control', Journal of Construction Engineering and Management, 124(1):11-17.

Barley, Stephen R, Kunda, Gideon (2001) Bringing Work Back In. Organization Science, Vol. 12, No. 1, pp. 76-95.

Button, G. and Dourish, P. (1996) 'Technomethodology: Paradoxes and Possibilities,' in A. Miller (ed.) Proceedings of the ACM Conference on Human Factors in Computing Systems CHI'96, Vancouver, BC, 19-26 April. New York: ACM. http://www.ics.uci.edu/%7Ejpd/publications/1996/chi96-technomethodology.pdf

Crabtree, A. (2004) 'Taking technomethodology seriously,' in European Journal of Information Systems, 13:195-209.

Davenport, T. H. & Prusak, L. (1997) Working knowledge; how organizations manage what they know, Harvard Business School Press, Boston, MA.

David, Albert & Hatchuel, Armand (2007) Des connaissances actionnables aux théories universelles en sciences de gestion. XVIème Conférence Internationale de Management Stratégique. Montréal, 6-9 Juin 2007.

Deming, W. E. (1986) Out of the Crisis: Quality, productivity and competitive position, Cambridge University Press, Cambridge.

Durkheim, E. (1933) The Division of Labour in Society.

Garfinkel, H. & Wieder, D. L. (1992) 'Two Incommensurable, Asymmetrically Alternate Technologies of Social Analysis', in G. Watson & R. M. Seiler (eds.), Text in Context, Sage, London, pp. 175-206.

Garfinkel, H. (1984) Studies in Ethnomethodology, Polity Press, Cambridge.

Heritage, J. (1984) Garfinkel and Ethnomethodology, Polity, Cambridge.

Hopp, W. and Spearman, M. (1996) "Factory Physics: Foundations of Manufacturing Management". Irwin/McGraw-Hill, Boston.

Howell, G., Macomber, H., Koskela, L. & Draper, J. (2004) 'Leadership and Project Management: Time for a Shift from Fayol to Flores,' proceedings of IGLC12, LO-School, Elsinore, Denmark, 25-27 July, http://www.iglc2004.dk/13722

Koskela, L. (2008) Editorial: Is a theory of the built environment needed? Building Research and Information. Special Issue, Developing Theories of the Built Environment, Vol. 36, No. 3, pp 211-215

Koskela, L. (2000). An exploration towards a production theory and its application to construction, VTT Technical Research Centre of Finland, VTT Publication 408.

Koskela, Lauri (2003) Is structural change the primary solution to the problems of construction? *Building Research & Information*. Vol. 31 No: 2, 85 – 96

Koskela, L., Siriwardena, M. & Rooke, J. (2008) 'Through-Life Management of Built Facilities: Towards a Framework for Analysis,' *1GLC16: Lean Construction: Making*

a Difference, Macdonald Manchester Hotel - Piccadilly Suite, Manchester UK, 16-18 July, pp 61-72.

Lynch, M (1999) 'Silence in context: ethnomethodology and social theory,' in Human Studies 22():211-233.

Macomber, H. & Howell, G (2003) 'Linguistic action: contributing to the theory of lean construction,' in IGLC11, Blacksburg, Virginia. http://www.iglc.net/conferences/2003/Papers/

Marx, K. (1976) Capital (Volume 1), Penguin, Harmondsworth.

Orlikowski, Wanda J.. 2007. Sociomaterial Practices: Exploring Technology at Work. Organization Studies 28(09): 1435–1448.

Pearce, D (2003) The social and economic value of construction: the construction industry's guide to sustainable development, The Construction Industry Research and Innovation Panel.

Pekericli, M. K., Flanagan, R., Jewell, C. & Lu, W. (2008) 'Vision 2020 – A whole life-cycle information management system for built environments' <https://www-edc.eng.cam.ac.uk/kim/files/Project%20Research/Draft%20Publications>

Pelzeter, Andrea. Building optimisation with life cycle costs – the influence of calculation methods. Journal of Facilities Management, Vol. 5 No. 2, 2007, pp. 115-128.

Rintala, Kai. The economic efficiency of accommodation service PFI projects. Espoo 2004. VTT Publications 555. 286 p. + app. 186 p.

Rooke, J. & Kagioglou, M. (2007) 'Criteria for evaluating research: the unique adequacy requirement of methods,' *Construction Management and Economics*, **25**(9):979-987.

Rooke, J. & Seymour, D. (2005) 'Studies of Work: Achieving Hybrid Disciplines in IT Design and Management Studies', Human Studies 28(2):205-221. http://www.ingentaconnect.com/content/klu/huma/2005/00000028/00000002/00004192

Rooke, J., Siriwardena, M. & Koskela, L. (2008) 'Methodological, Philosophical and Theoretical Developments in Conceptualising Product-Service Knowledge' (Abstract only) KIM Project Conference 2008: Knowledge and Information Management Through Life, University of Reading, 2nd - 3rd April; (Full paper) https://www-edc.eng.cam.ac.uk/kim/files/Project%20Research/Draft%20Publications

Ryle, G. (1963) The Concept of Mind, Penguin, Harmondsworth.

Seymour, D. & Rooke, J. (1995) 'The culture of the industry and culture of research', in *Construction Management and Economics*, **13**(6):511-523.

Shewhart, Walter A. & Deming, W. Edwards. 1939. Statistical Method from the Viewpoint of Quality Control. The Graduate School, The Department of Agriculture, Washington. 155 p.

Siriwardena, M., Rooke, J., Koskela, L. Kagioglou, M., McDermott, P., Sexton, M. & Aouad, G. (2008) 'Procurers, Providers and Users (PPU): towards a meta-role model for conceptualising product-service in the built environment,' (forthcoming) BEAR 2008: Building Resilience, Kandalama Hotel, Sri Lanka.

Spear, Steven J. 2002. The essence of just-in-time: embedding diagnostic tests in work-systems to achieve operational excellence. Production Planning & Control, Vol. 13, No. 8, 754 – 767.

Weber, M. (1930) The Protestant Ethic and the Spirit of Capitalism, Unwin, London.

Wenger, E. (1999) Communities of Practice: learning, meaning and identity, Cambridge University Press, Cambridge.

Appendix 1

Lauri Koskela

Research programme on design and production

This research programme started in 1991 (Koskela 1992) from the observation that the mainstream approach was looking at production as a *transformation (T)*, whereas the JIT approach was based on an idea of production as a *flow (F)*. Somewhat later, a third conceptualization of production was discovered, namely as *value generation (V)*. Historical analysis revealed that there have been competing production templates based on these three conceptualizations, but curiously, these concepts do no figure in standard text book presentations of production management (Koskela 2000), in spite of their face value for explanation. It is also argued that the same concepts have underpinned some recent thinking in design management (Koskela, Huovila & Leinonen 2002).

The next topic to address was *management* of production, explored in the framework of project management (Koskela & Howell 2008). It turned out that the mainstream approach to managing production, conceptualized as transformation, could be reduced to three theoretical concepts: management-as-planning, dispatching, thermostat control. Again alternatives could be identified: management-as-organizing, language-action perspective, scientific experimentation model. Both the mainstream and alternative concepts are used in an implicit manner.

Furthermore, the task of explanation of the T, F and V concepts was embarked on. One source of explanation is made up by the metaphysical presuppositions of the production concepts (Koskela& Kagioglou 2005). It is argued that the T model is hardly else than the thing metaphysics, as applied to production. The F and V models subscribe to the process metaphysics, although not totally. Especially, the popular model of production based on the queueing theory fails to allow for emergent properties for a job. In so doing, it prevents from seeing one major waste in construction production, namely that of *making-do* (Koskela 2004). Another source of explanation is to look at the historical evolution of the production concepts. In this sense, the value generation model turns out to be fascinating. In (Koskela& Kagioglou 2007), it is argued that the ancient method of *geometrical analysis* provides a proto-theory for designing and producing an artefact, starting from a need. Afterwards, it was discovered that actually Aristotle had suggested this idea (Koskela & al., in review). Geometrical analysis was a sophisticated procedure already in the classical period, and this suggestion was thus of great substance and potential significance. Unfortunately, there has not been any follow-up of this idea up to our times. Still, it can be argued that an understanding of design based on the ancient geometrical analysis is broader and at least partially deeper than its current rivals (Koskela & al., in review).

Lastly, critical work has been done in relation to the neglected or denied place of production in disciplines directly or indirectly related to it. This neglect and denial is spectacular against the backcloth that the *science of production* was one of three

sciences in the taxonomy of Aristotle. Thus, it has been contended that *project management* should be based on production theories rather than on economics (Koskela & Ballard 2006). In *economics*, there is a specific theory of production, but it is argued to be outdated and counterproductive (Koskela, in print). In work still underway, *organizational theory and management science* are analyzed. As leading organizational theorists are ready to admit, organizational theory has avoided the phenomena of work or materiality, both issues belonging to production. The emerging argument is that organizational theory is oddly and critically hollow: the usual *raison d'être* of an organization, to produce something, is not adequately conceptualized. Surely, there have been voices towards a better inclusion of design and production into the scientific explanation of organizing and managing, but they remain in the margin. It is difficult to avoid the somewhat harsh conclusion that there is a large blind spot in the vision of organizational theory and management science – so large that it creates a shadow of suspicion on the validity of research results of these fields, if they concern settings related to designing and producing.

Overall, two major arguments arise from this research programme. There has been

- a longstanding neglect and denial of the theories of design and production, both in the disciplines purportedly addressing designing and producing, and in the disciplines addressing wider wholes where designing and producing takes place, and as a consequence of this,
- weakened explanatory power and business relevance of these disciplines have emerged.

References

Koskela, Lauri. (1992) Application of the new production philosophy to construction, Stanford University. 75 p. CIFE Technical Report; 72.

Koskela, Lauri. (2000) An exploration towards a production theory and its application to construction. Espoo, VTT Building Technology, 2000. 296 p. VTT Publications; 408. ISBN 951-38-5565-1; 951-38-5566-X. WWW: http://www.inf.vtt.fi/pdf/publications/2000/P408.pdf

Koskela, Lauri. (2004) Making-Do – The Eighth Category of Waste. Proceedings of 12th Annual IGLC Conference on Lean Production, Denmark 2004 Ed. by Sven Bertelsen & Carlos T. Formoso. Elsinore, Denmark Pp: 3-12

Koskela, L. (in print) On the theory of production in economics and production management. Modern Construction Economics: New Developments in Theory, ed de Valence, G.

Koskela Lauri & Ballard Glenn, (2006), Should project management be based on theories of economics or production?, Building Research and Information Vol 34, Iss 2, pp 154-163 March

Koskela, L., Codinhoto, R., Tzortzopoulos, P. & Kagioglou, M. (Under review) The Method Of Analysis Of The Ancient Geometers As The Proto-Theory Of Design

Koskela, L. & Howell, G. (2008) The Underlying Theory of Project Management Is Obsolete. Engineering Management Review, IEEE. Volume 36, Issue 2, Pages 22-34.

Koskela, Lauri; Huovila, Pekka; Leinonen, Jarkko. (2002) Design management in building construction: from theory to practice. Journal of Construction Research. Vol. 3 No: 1, 1-16.

Koskela, Lauri & Kagioglou, Mike (2005) On the Metaphysics of Production. The 13th IGLC Conference, Sydney.

Koskela, Lauri & Kagioglou, Mike, (2006) The Proto-Theory of Design: the method of analysis of the ancient geometers. Proceedings of the Design 2006, 9th International Design Conference