L. Stapleton, (2001). 'From Information Systems in Social Settings To Information Systems as Social Settings: A Study of Large Information Systems in Manufacturing Firms', *Proceedings of the 7th IFAC Symposium on Automation Based on Human Skill: Joint Design of Technology and Organisation,* ed. Brandt, D. and Cernetic, J., Elsevier: North Holland.

FROM INFORMATION SYSTEMS IN SOCIAL SETTINGS TO INFORMATION SYSTEMS AS SOCIAL SETTINGS

Larry Stapleton,

Department of Computing,

Waterford Institute of Technology, Republic of Ireland

Abstract: Research into the social impact of automation sees automation systems as separate entities to the social systems that they affect. This paper examines this research position. Social systems are defined as systems of organisation and work involving human cooperation and inter-relations (adapted from OED 1990). It explores the possibility that some automation systems are themselves social systems. This proposition reframes the question of social impact by placing the impacting system as part of the impacted social system. Manufacturing information systems (IS) are presented as an example of automation applied to information processing. Manufacturing IS's attempt to provide streamlined, automated information processing in their host organisations. Information systems development (ISD) methodologies are centred upon delivering a technical solution in this space. The focus upon technology in ISD de-emphasises the social impact of these systems and places the technical system outside the impacted social system. This paper briefly summarises results from an empirical study, which reveals that the delivery of a new information system means the delivery of a new social system. This social system is the primary outcome of ISD. This issue is not explicitly recognised by most current research trajectories. This paper contends that the implications of this are extremely significant for research and development of complex automata for information systems. *Copyright* © *2000 IFAC*

Keywords: Information Analysis, Information Systems, Information Theory, Social Requirements, Social Impact of Automation, Systems Concepts and Methodologies

1.INTRODUCTION

Information Systems Development (ISD) approaches utilise formalised systems analysis and design methodologies in order identify IS requirements, formulate functional specifications and, from there construct, test and deploy the new information system. In some cases IS construction phase requires programming the new system from scratch, in other cases (such as large manufacturing business information systems) it requires the extensive configuration and parameterisation of vendor-supplied system modules. ISD approaches generally focus upon deriving functional descriptions of desired systems that can be implemented within the organisation. These premises have dominated ISD research and practise, a fact which is well documented elsewhere (Myers, 1995; Klein & Hirschheim, 1991; Galliers, 1993). ISD approaches are typically based upon a mechanistic view of organisational activity as described in Morgan (1986). The underlying assumptions are largely based upon a functionally rationalistic perspective of organisational behaviour. Functional Rationalism relies upon the notion that there is an objective world 'out there', which can be formally described according to a set of logical models and statements i.e. that the world can be, captured adequately using logical, functional descriptions (Siddiqi, 1994). Functional rationalism is derived from the positivism which was outlined during the Enlightenment by philosophers such as Kant in his Critique of Pure Reason (Kant, 1781). In this century Ayer's 'Language, Truth and Logic' (Ayers, 1936) is considered to be the founding text of modern positivistic thought and has dominated much of British and American philosophy since its

L. Stapleton, (2001). 'From Information Systems in Social Settings To Information Systems as Social Settings: A Study of Large Information Systems in Manufacturing Firms', *Proceedings of the 7th IFAC Symposium on Automation Based on Human Skill: Joint Design of Technology and Organisation*, ed. Brandt, D. and Cernetic, J., Elsevier: North Holland.

publication. This rationalistic view has been adopted by IS theorists in the area of methodologies. The machine-based view of IS embodied in functional rationalism relies upon an ability to reduce organisational activity into a set of rationalistic descriptions, which can be understood in logical terms. Specifications of business processes and/or software programming are constructed from the functional descriptions. These specifications are then converted into the computer-based information systems functionality to be implemented in the organisation at some specific point in time – the 'deadline' for the project. Activities after this deadline are termed 'post-implementation' or 'maintenance' and are typically concerned with routine operational maintenance (Avison & Fitzgerald, 1995; Taylor, Moynihan & Duffy, 1996).

These emphases have led to well-documented problems in the field. In particular, they ignore the complexities and ambiguities of organisational information processing by assuming that a social system can be reduced to useful functional descriptions (March, 1987; Stapleton, 1999). This posture ignores the intractability and dynamism of social information processing (Hayek, 1952; Loadsby, 1976; Paul, 1993). Indeed Business Process Re-Engineering (BPRE) advocates ISD as a means of implementing organisational change in companies, further emphasising the role of ISD in delivering dynamic social processes, rather than fixed and stable software functionality (Cougar, Flynn & Hellyer, 1994). A number of writers have attempted to address the social context within which information systems must be developed. This work has been underway for almost twenty years. One major outcome are 'Soft Systems Methods' or 'SSM' (Checkland, 1981; Checkland & Scholes, 1991). SSM attempts to address social issues associated with the deployment of a new information system by focussing upon 'actors', 'customers' etc. during requirements analysis. However, it has become apparent that SSM does not reframe ISD into a social context. Rather, it maintains an inexorable course towards a technical artefact (Flynn 1992). In short it does not see the information system itself as a social system. The possibility that the information system is a social system has been often hinted in IS literature (Boland & Day 1989, Hirschheim & Newman (1991). However, very little research has attempted to ascertain this empirically or delineate the research implications of this proposition. So, the question remains, is the outcome of information systems development a social system?

2. RESEARCH

An empirical study was conducted across nine manufacturing firms utilising a field research approach. The researcher interviewed forty-eight people who were actively involved in the information systems development project in their firm. In eight of the nine firms Enterprise Resource Planning (ERP) systems development was investigated. In one case the introduction of an EDI system as part of a Manufacturing Quality strategic initiative was studied.

Methodologies used in these firms drew heavily from positivistic views of rational organisational activity. They employed a phased approach, with an early requirements stage during which models of system functionality were constructed, a system construction phase which involved the parameterisation and programming of the new system. Typically, the next stage involved a prototyping exercise and included training and test. Finally the project moved into an implementation stage. The post-implementation stage was only explicitly and formally established in one firm – company F. Senior management had learned from bitter experience the need to establish a lengthy and well-resourced post-implementation process. This was a significant success factor in this firm. As one manager explained '*you don't implement on the due date – you cutover. The real implementation work starts after you go live'*. Participants in other firms told of '*the consultants leaving three days after the implementation'*. In all firms this ISD was part of an overall enterprise-wide solution to the problem of providing coordinated, automated information processing. The approach used a new enterprise information system development project to lever change. This link between change management and systems development and deployment is very common in contemporary ISD and is recognised by IS research (Stapleton (1998), Moreton & Chester (1999), Cernetic & Jerman (1999)).

Interviewees were from all management levels. The work presented herein is part of a larger study into the nature of automated information processing in large manufacturing companies. Projects were selected only if they had an impact upon more than one functional area. This is to ensure a reasonable level of complexity during ISD. The questionnaire uses Likert scales in order to gather quantitative data, but recognises that the most important data is gathered by way of the discourse that surrounded each question. A pilot study was undertaken in one of the firms and an adapted form of grounded theory was employed in order to develop the research instrument (Glaser & Strauss (1967), (Miller & Dunne 1999)). The pilot firm results are not presented here. All interviews were confidential. The list of participating firms with their associated industrial sector is given in Appendix 1. The mean

values of quantitative results from the interviews are presented in table 1.

It is apparent from the first two rows of the table that a great deal of energy was expended after implementation of the system. This phase of ISD is largely ignored by IS research. Question five shows that the support processes within which this energy was expended was a major outcome of all projects except company G. Company G reported huge problems as a result of not establishing an ongoing support process after implementation. This explains the results for this company for question 6 and 6i). The qualitative data reveals that most post-implementation activity was associated with 'bedding in' the system into the other organisations. This work was very extensive and continued for a minimum of eighteen months after initial implementation. In all cases (except G) post-implementation activity involved organisational support including learning to work within the confines set out by the new system, and understanding the impact of the system's functionality upon both work practises and organisational relationships. Many people felt that they could not make sense of what the new system meant and they required extensive ongoing support in order to come to terms with the new work environment introduced by the system.

Question 7 asks the extent to which system requirements were satisfied by software development or modification. The results are very surprising. In none of the companies did the bulk of requirements require software modifications. Whilst there was a well defined system construction phase in all projects, the major means by which requirements were satisfied was the development of learning processes in the post-implementation stage and addressing non-technical issues, including preparation of the organisation for the new system. Questions 6 and 6i) reveal that change was central in all companies except company G where it was ignored. This company experienced severe difficulties as a result. The results indicate that the outcome of ISD was not only a technical artefact but a changed organisation.

The actual experiences of the local sites were, generally, quite traumatic. The trauma was often associated with attempts to make sense of the intractable complexity of the new world, which the development process introduced into the organisation when the new IS was implemented. Consequently, there was evidence for very high levels of accelerated learning within the organisation that often took place under highly stressful conditions. These conditions were exacerbated by the fact that the ISD approaches that the companies had adopted did not recognise the social aspects of ISD and the post-implementation world. Managers were left with few guidelines and users often felt unsupported, confused and isolated, particularly in company G. In all companies, except F, respondents generally felt that there was room for improvement in the support processes, which were often established by default rather than design. In company F management realised the need for this process and set aside significant resources for extensive post-implementation support. This contributed significantly to the successful outcome of ISD in the firm.

The qualitative data reveals that the information system was a centre around and within which organisations made sense of change. The key to successful implementation was the learning and education process by which people made sense of the new world introduced by the new system. This new world includes changed work practises, changed relationships and changed information processing i.e. a changed social system. The integration of automated IS required new knowledge such as the inter-functional impacts of particular behaviours (e.g. the deletion of a part number could affect not only engineering, but numerous other functional areas). The ISD process was a means by which new work practises, management concepts and knowledge were diffused throughout the firm. However, the literature associated with IS engineering has rarely emphasised this view. Even soft-systems methods suffer from the criticism that, in the final analysis, the IS is seen as a technical artefact in a (limited) social setting, rather than as a social setting itself (Flynn, 1992; Stapleton, 1999).

Table 1 Results of the Questionnaire: Mean Values of Responses by Company

COMPANY:	A	B	C	D	E	F	G	H
1. After implementation did people spend much energy fitting the software to work practises?	2.9	3.2	2.5	3.5	3.2	2.8	1.3	1.3
2. After implementation did people spend much energy fitting the work practises to the software?	5.0	3.4	4.5	4.5	3.4	4.8	3.8	4.0
3. Did the outcome of ISD include establishing an ongoing organisational support process?	4.9	4.4	5.0	4.3	4.0	5.0	2.5	5.0
1= none established 5= extensive process established								
4. Did/does this process work well? *1= very well 5 = very poorly*	2.6	2.1	1.5	1.3	2.6	1.4	3.5	1.7

5. To what extent was the establishment of a post-implementation support process satisfactory?	1.7	1.7	2.3	1.8	2.6	1.0	3.8	1.3
1 = satisfactory *5= unsatisfactory*								
5 i) - Did this contribute to the success of the project?	4.3	3.4	5.0	5.0	4.6	5.0	3.2	5.0
6. Were changes in the way people would work a key issue?	4.7	3.8	4.5	5.0	3.8	5.0	2.8	5.0
6 i) Was this issue addressed?	4.3	4.0	5.0	5.0	4.0	4.8	1.5	4.3
7. Were requirements often satisfied without developing or modifying software?	3.4	4.2	4.0	2.8	3.4	3.8	4.3	4.0
1= modifications often required *5 = rarely required*								

Key: Likert values range on an ordinal scale from one to 5. Unless stated 1 = not at all, 3 = somewhat, 5 = very much so

3. CONCLUSIONS

The study reveals that ISD is a social process with technical aspects. This paper asserts that the functional rationalism which underpins ISD and the IS post-implementation or 'Maintenance' phase ignores the fundamentally social nature of both the systems development process and the outcome of large-scale systems development and automation. In the firms studied here the primary result of ISD was new social processes. The field research further suggests that systems development activities must explicitly recognise this fact and provide a focus for the creation and management of organisational support processes, particularly after implementation of the system.

The very brief analysis of results presented in this short paper reveal that the primary activity during ISD was the establishment of social processes which enabled the organisations to make sense of the new system. The qualitative data reveals that this sensemaking process was an absolutely critical aspect of ISD that is not addressed explicitly by any of the development methodologies to date. It also reveals that a great deal of very important ISD activity occurs for an extended period after initial implementation. In short, the paper reframes ISD as follows:

- The outcome of ISD is primarily a social process with attendant technical systems
- The outcome of ISD emerges over an extended period and is dynamic and evolving.

This suggests two major trajectories for future research into the social impact of automated systems

1. To what extent are other automation systems a locus for social systems development?
2. How do we construct guidelines for the construction of automated systems which are social systems?

Organisational sensemaking theory provides an excellent basis for such a revised perspective (Weick (1982, 1985, 1995), Ring & Rands (1989), Louis (1980), Stapleton (1999)) and will inform future research in the field. Rather than looking at the social impact as something other than the technical artefact, our research must construct models which see the technical artefact as the locus for social systems development. This opens up a whole new set of possibilities, and requires ISD and related research to rethink the appropriateness of the philosophical positions underlying many current research trajectories.

REFERENCES

Avison, D.E. & Fitzgerald, G. (!995). *Information Systems Development*, 2nd Edition, McGraw Hill: London.

Ayer, A.J. (1936). *Language, Truth & Logic: The Classic Text Which founded Logical Positivism and Modern British Philosophy*, Penguin Books, reprinted 1991 (first published by Victor Gollanez, 1936 & reprinted in 1946).

Boland, R. & Day, W. (1989). The Experience of Systems Design: A Hermeneutic of Organisational Action, *Scandinavian Journal of Management*, 5, 2, pp. 87-104.

Cernetic, J. & Jerman, S. (1999). A Soft Change-Management Approach Applied to Information Systems Development, in *Evolution and Challenge in Systems Development*, Zupancic, J., Wojtkowski, W., Wojtkowski, W.G., Wrycza, S., (eds.), Kluwer Academic/Plenum Publishers: New York, pp. 389-404.

Checkland, P. & Scholes, J. (1990). *Soft Systems Methodology in Action*, Wiley: Chichester.

Cougar, Flynn, P. & Hellyer (1994). Enhancing the Creativity of Reengineering, *Information Systems Management*, 11, 4, pp. 24-29.

Flynn, P. (1992). *Information Systems Requirements*, McGraw Hill.

Glaser, B. & Strauss, A. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*, Aldine: Chicago.

L. Stapleton, (2001). 'From Information Systems in Social Settings To Information Systems as Social Settings: A Study of Large Information Systems in Manufacturing Firms', *Proceedings of the 7th IFAC Symposium on Automation Based on Human Skill: Joint Design of Technology and Organisation*, ed. Brandt, D. and Cernetic, J., Elsevier: North Holland.

Hayek, F.A. (1978). The Pretence of Knowledge, in *New Studies in Philosophy, Politics and the History of Ideas*, F.A. Hayek, Routledge & Keegan Paul Ltd.

Kant, I. (1781). *A Critique of Pure Reason*, English Translation by Smith, N.K. (1978), Harold MacMillan.

Klein, H.K. & Hirschheim, R. (1991). Rationality Concepts in Information System Development Methodologies, *Accounting, Management and Information Systems*, 2, 2.

Hirschheim, R. & Newman, M. (1991). Symbolism and Information Systems Development: Myth, Metaphor and Magic, *Information Systems Research*, 2, 1.

Loadsby, B. (1976). *Choice, Complexity and Ignorance: An Enquiry Into Economic Theory and the Practise of Decision Making*, Cambridge University Press: UK.

Louis, M. (1980). Surprise and Sense-making: What Newcomers experience in entering unfamiliar organisational settings, *Administrative Science Quarterly*, 25, pp. 226-51.

March, J.G. (1987). Ambiguity and Accounting: The Elusive Link Between Information and Decision Making, *Organisations and Society*, 12, pp. 153-68.

Miller, K. & Dunne, D. (1999). Using Past Performance to Improve Future Practise: A Framework for Method Evaluation and Improvement, in Zupancic, J., Wojtkowski, W., Wojtkowski, W.G., Wrycza, S., (eds.), *Evolution and Challenge in Systems Development*, Kluwer Academic/Plenum Publishers: New York, pp. 99-108.

Moreton, R. & Chester, M. (1999). Reconciling the Human, Organisational and Technical Factors of IS Development, in *Evolution and Challenge in Systems Development*, Zupancic, J., Wojtkowski, W., Wojtkowski, W.G., Wrycza, S., (eds.), Kluwer Academic/Plenum Publishers: New York, pp. 389-404.

Morgan, G. (1986). *Images of Organisations*, Sage Publications: CA.

Myers (1995). Dialectical Hermeneutics: A Theoretical Framework for the Implementation of Information Systems, *Information Systems Journal*, 5, 1 (January), pp. 51-70.

OED (1990). *The Oxford Dictionary*, H.W. Fowler & F.G. Fowler (eds.), eighth edition further edited by R.E. Allen, BCA: London (by arrangement with Oxford University Press).

Paul, R. (1993). 'Why Users Cannot "Get What They Want"', *SIGOIS*, December, ACM Press.

Ring, P. & Rands, G. (1989). 'Sense-making, Understanding & Committing: emergent interpersonal transaction processes in the evolution of 3Ms microgravity research program', in *Research on the Management of Innovation: The Minnesota Studies*, Ballinger, Van de Ven, A., Angle, H. & Poole, M. (Eds.), pp. 227-366.

Siddiqi, J. (1994). 'Challenging the Universal Truths of Requirements Engineering', *IEEE Software*, March.

Stapleton, L. (1998). 'Spirals of Sense-making: Making Sense of a Changing World', *Proceedings Of Colloquium of European Group of Organisational Studies* (EGOS 1998), University of Maastricht, Holland.

Stapleton, L., (1999). 'Information Systems Development as Interlocking Spirals of Sensemaking', in *Evolution and Challenge in Systems Development*, Zupancic, J., Wojtkowski, W., Wojtkowski, W.G., Wrycza, S., (eds.), Kluwer Academic/Plenum Publishers: New York, pp. 389-404.

Taylor, Moynihan & Duffy (1996). 'The Problems of Systems Maintenance Management', *Information Systems Methodologies 1996: Proceedings of the Fourth Conference of the British Computer Society Information Systems Methodologies Specialist Group*, Jayaratna, N. & Fitzgerald, B. (eds.), British Computer Society, pp. 427-438.

Weick, K (1982). 'Management of Organisational Change amongst Loosely Coupled Organisational Elements', in *Change in Organisations*, Goodman, P. and Associates (Eds.), Jossey-Bass, pp. 375-408.

Weick, K (1985). 'Chaos & Cosmos: sense & nonsense in electronic contexts', *Organisational Dynamics*,14,2.

Weick, K (1995). '*Sense-making in Organisations'*, Sage Publications: Thousand Oaks, U.S.

Appendix 1: Firms That Participated in the Research Study (Including the Preliminary Study):

- ABB Transformers: Electrical Engineering Products
- ABS Pumps: Mechanical Engineering Products
- Allied Signals Ireland: Electrical Engineering &

L. Stapleton, (2001). 'From Information Systems in Social Settings To Information Systems as Social Settings: A Study of Large Information Systems in Manufacturing Firms', *Proceedings of the 7th IFAC Symposium on Automation Based on Human Skill: Joint Design of Technology and Organisation*, ed. Brandt, D. and Cernetic, J., Elsevier: North Holland.

Aerospace Products

- Allsop Europe: Consumer Electronics
- American Can Company: Metal Packaging
- Louisiana Pacific Europe: Building Products
- Norton Pharmaceuticals: Healthcare
- Honeywell-Measurex: Electrical Engineering Products
- Waterford Crystal: Glassware