environment that strongly supports the primary objectives of that organisation." FM involves more than the maintenance and management of the building and building services that it is usually associated with. Its goal is organisational effectiveness i.e. helping the organisation to allocate its resources in a way that allows it to flourish in competitive and dynamic markets (Becker, 1990).

SPICE FM is a current research project at Salford University, developing a process improvement framework for this sector. The concepts behind this framework originated from process improvement research in the software sector [Paulk 1995]. In order to establish a common understanding, we first discuss what process thinking is and how it differs from function-based thinking.

Process Thinking

Function based thinking has dominated industry for the last two centuries. This in turn translates into functional organisation structures. In this structure, each discipline carries out its own activities, without much thought for how it fits into the activities of other disciplines. There is a communication wall between the various professions and organisations, and adversary cultures are predominant. In this type of structure customer focus becomes clouded and many life cycle issues are undermined.

In order to deliver services and products to customers, various processes need to be undertaken. There are many definitions of a process. Davenport [1993] explains that a process is "simply a structured, measured set of activities designed to produce a specified output for a particular customer or market". Other researchers have provided other definitions [Paulk 1995]. FM processes are a set of activities, which provide 'physical' support (including spatial, environmental, human and financial resources) to the primary activity of a business organisation [Nelson et al 2000].

Process thinking across a business aligns the behaviour and activities of those teams towards achieving their common goal. It brings consistency and uniformity to the team's behaviour, which turns into improved capability and better quality of results and improved supply chain relationships. Without a focus and alignment towards common goals, the activities of the different team members could become contradictory, thus degrading the total effectiveness of the team [Zahran 1998].

Process thinking is present at the highest levels of businesses across many industries. Due to fast changes in the market place and client expectations, task oriented thinking has become outdated. Many managers adhere to process thinking. The problem has been the implementation of this thinking across the organisation [Zahran 1998]. In order to implement process thinking, it is important to define and institutionalise key processes. Many researchers have focused on process mapping, in order to initiate process thinking [Bjork, 1994; Kagioglou, 1999; Kagioglou et al, 1998a, b, c; Sanvido, 1990; Walker, 1989]. Process mapping is important for creating a process definition. However, the challenge of institutionalising the processes still remains.

Process Institutionalisation

A process shapes the way we act and react. The behaviours, activities and tasks we perform to

achieve a certain goal represent the process for achieving that goal. A disciplined process will manifest itself in ordered and consistent patterns of behaviours, whether by an individual or by a group of people following a common process. The process defines the way we act or react in a certain situation, or the activities to fulfil a certain task.

A process performed professionally and naturally by a person, is described as "personalised" by that person. In organisations the processes involve groups and teams of people. To get an organisation wide process discipline, the process needs to be established or "institutionalised" in the organisation [Zahran 1998]. Without established processes across the organisation, every individual will follow his or her own way of performing the task. Adherence to a common process is likely to be ad-hoc and sometimes chaotic.

On the other hand, in organisations where common processes are institutionalised, staff will perform the process "painlessly", smoothly and in harmony with each other. The process itself becomes "transparent" because it becomes the natural way of performing business activities.

Process / Business Mapping

Business modelling is a range of diagrammatic and analysis techniques that represent the enterprise and its environment, whilst process modelling is the graphical representation of the decision-making and data transformation processes that make up a business area [Nelson et al, 2000]. There is a need to model business processes as this:

- Helps to graphically depict the multiple facets of a business area
- Enables the conveyance of an objective representation of a business problem so that it can quickly be understood by a team

Enables Process Management, which embraces a wide range of disciplines, techniques and approaches based on the identification, control and improvement of business processes. This improvement includes both radical and incremental continuous change (Sterling Software, 1999).

Key Research Aim

SPICE FM seeks to develop an incremental process improvement framework for FM. Within this framework, organisations will be able to define and institutionalise process and process improvement initiatives.

SPICE FM framework builds on a similar research for the construction sector, namely the SPICE model. Industry has found the SPICE research valuable. Though this research is still new, one major UK contractor is already implementing SPICE.

THE SPICE FRAMEWORK

Structured Process Improvement for Construction Enterprises (SPICE) is a research project that is developing a process improvement framework for the construction industry. Increasing evidence from other sectors [Imai 1986, Paulk 1993] shows that continuous process improvement is based on many small, evolutionary steps, rather than revolutionary measures. The philosophies of W. Edwards Deming [1986] & Joseph Juran [1988] teach that real process improvement must follow a sequence of steps, starting with making the process visible, then repeatable, and then measurable. Using this philosophy, the SPICE project has been developed

as an *evolutionary step-wise* model utilising extensive experience from the IT sector. SPICE focuses specifically on the use of the Capability Maturity Model (CMM) [Caputo, 1998; Paulk 1993, Saidian 1995] which was developed for, and is used by the United States Department of Defence.

The SPICE framework is composed of five evolutionary improvement levels [Sarshar 1999, 2000]. Each level is characterised by a number of key processes, as shown in table 1. The model is incremental. To reach a level of maturity, organisations must implement all the key processes of that level, "appropriately".

Table 1: SPICE maturity levels and key processes

Level 5 Continuously Improving	**Key processes from original CMM®: -** ▪ Process change management ▪ Technology change management ▪ Defect prevention
Level 4 **Quantitatively Controlled**	**Key processes from original CMM®: -** ▪ Quality management ▪ Quantitative process management

Level 3 **Well Defined**	**SPICE recommended key processes: -** ▪ Organisation process definition ▪ Organisation process focus ▪ Integrated design & construction management ▪ Construction life cycle engineering ▪ Training programme ▪ Peer reviews

Level 2 **Planned and Tracked**	**SPICE key processes** ▪ Brief and scope of work management ▪ Project planning ▪ Project tracking and monitoring ▪ Subcontract management ▪ Project change management ▪ Health and safety management ▪ Risk management ▪ Project team co-ordination
Level 1 **Initial**	No Key Processes

Process Enablers
How can the manager ensure that key processes are performed "appropriately"? Zahran (1998) differentiates between "incomplete processes" as opposed to "disciplined processes", and lists a number of characteristics for these. Paulk (1995) also lists a number of "key management features" for a complete and coherent process. Based on these philosophies, SPICE has developed a number of "process enablers".

Process enablers are generic characteristics, for any disciplined process. They focus on results, which *can be expected to be achieved* from a key process. This is a forward-looking approach,

which indicates process capability *before* a process takes place. They provide detail of features, which a key process must posses in order to yield successful results. Ensuring that all the process enablers are in place, improves the performance and predictability of key processes. Process enablers are common across all the key processes. SPICE process enablers are briefly listed below [Sarshar 2000]:

- **Commitment -** This criterion ensures that the organisation takes action to ensure that the process is established and will endure. It typically involves establishing organisation policies, and senior management commitment.
- **Ability -** This describes the preconditions that must exist to implement the process competently. It normally involves adequate resourcing, appropriate organisational structure, and training.
- **Verification -** This verifies that the activities are performed in compliance with the process that has been established. It emphasises the need for *independent, external* verification by management and quality assurance.
- **Evaluation / Measurement-** This describes the basic *internal* process evaluation and reviews and some measurement mechanisms.
- **Activities -** This describes the activities, roles and procedures necessary to implement processes. It typically involves establishing plans and procedures, performing the work, tracking it, and taking corrective action as necessary.

The Assessment Mechanism

The SPICE assessment mechanism ensures that each key process has reached capability by testing it against the above "process enablers". The assessment would generally comprise of three elements: a questionnaire, interviews of key personnel and a document review.

The assessment team review the results to establish whether each key process is 'capable'. This process allows the assessment team to "hold a mirror in front of the project team". The findings are shared with the project team, who use these results to plan improvement activities.

The combination of these key processes viewed as a whole, will place the organisation at a level of process maturity in the model. An organisation can only be considered to be at a particular level in the model if *all* the key processes are deemed capable at that level.

SPICE FM RESEARCH

The SPICE FM research aims to tailor the SPICE model for the requirements of facilities management. It intends to develop an incremental process improvement framework. The SPICE model lacks explicit links to top-level business requirements and has little focus on supply chain management issues. To overcome these problems, SPICE FM aims to link the SPICE concept to two other models, in a seamless manner, namely: (i) The Balanced Score Card (BSC)[Kaplan 1992, 1993, 1996]; and (ii) The Integrate to Innovate (i2i) supply chain management model [Barrett et al1998].

The Balanced Score Card is an increasingly popular board-room technique for measuring performance criteria that are not immediately linked to bottom-line profits, but will have an impact on future profits, is the so-called Balanced Scorecard. Devised by Harvard Business School Professor Robert Kaplan and Renaissance Solutions President David Norton, this

management system proposes a system, which integrates measures of four different perspectives, namely: (i) customer satisfaction, (ii) process performance, (iii) product or service innovation and (iv) finance. Kaplan and Norton (1992) suggested that what is needed is "a balanced presentation of both financial and operational measures".

The i2i project looked at issues relating to innovation and knowledge management within the construction industry, aiming to (i) clarify between desirable and undesirable innovation and (ii) identify, calibrate and measure internal and supply chain innovation processes. It identified five levels knowledge management namely: information transfer (at the lowest level 1), knowledge exchange, knowledge collaboration, innovation chain, and innovation network (at the highest level 5). It emphasises the fact that appropriate innovation needs to support strategic corporate and supply chain objectives, whilst focusing on creating and/or sharing knowledge which adds significant value to individual firm and supply chain performance. It is therefore important to have a balanced portfolio of supply chain relationships. Strong links to competitiveness were identified as the motivation to innovate, whilst the management of the unique characteristics of the supply chain environment, alignment with strategic direction, commitment of senior management and organisational resources and knowledge management were identified as the essential ingredients for successful innovation [Barrett et al 1998].

The key research questions in SPICE FM are:
- Is the SPICE framework applicable in the FM sector? Are the key processes meaningful and are the process enablers generic in this domain?
- Can we enrich the SPICE model, with the BSC, in a seamless manner? One of the four perspectives of the BSC is process performance. Is SPICE: complimentary to this perspective? Or can it replace this perspective?
- Can we add supply chain capabilities to the SPICE model, using the i2i model?

Questions 2 and 3 are beyond the scope of this paper. However, the paper will present some early findings related to question 1.

Research Approach & Methodology
SPICE FM is developed in collaboration with the NHS Estates (National Health Service). The research is initially conducted in a large local hospital. In order to generalise the results, once an initial model proves suitable for this hospital, the case studies will be extended to other hospitals, as well as other FM organisations. The research team has a small management team. There is a steering committee of 18 senior managers and senior academics, which review the findings on a regular basis. There is also an advisory panel, which acts as an expert opinion elicitation panel.

Researchers have used a combination of semi-structured interviews, case studies and expert opinion elicitation meetings to establish the validity of the SPICE framework. This is in accordance with the triangulation strategies. Stake [1995] states that the protocols that are used to ensure accuracy and alternative explanations are called triangulation. Snow & Anderson (cited in Feagin et al, 1991) asserted that triangulation occurs with data, investigators, theories and methodologies. The assumption in triangulation is that the effectiveness of triangulation rests on the premise that the weaknesses in each single method will be compensated by the counter-balancing strategies of another (Jick, 1979). The need for triangulation arises from the

ethical need to confirm the validity of the process. In this study this was achieved by using multiple sources of data: survey questionnaire, interviews and documents evaluation, and use of multiple investigators, as described by Yin (1994).

Initially it was important to scope the studies and agree the scope with the FM managers. The scope of studies was the FM operations within the hospital. These operations can be split into three major functions: (i) Managing Estates Services; (ii) Managing Hotel Services; and (iii) Managing Designs and Projects. The first of these functions was selected for initial studies. 150 people work within this function.

Interviews: Understanding the Organisation
Initially the research team conducted semi-structured interviews and document reviews to understand the activities within "Managing Estates Services" and capture some of the organisational problems and the improvements necessary. These interviews were independent from the SPICE FM model. The main purpose was to understand the organisation, its main activities and some common beliefs. The interviews were limited to senior and middle management levels at this stage, to keep the number of interviews manageable.

The researchers used process-mapping techniques to understand and communicate the processes within "Managing Estates Services". The researchers also aimed to establish some base process maps for FM functions, within the UK hospitals. These maps could then be tailored to the requirements of each hospital, with little extra effort. An object-oriented process mapping package was used to capture the results. Figure 1 shows an Activity Decomposition Diagram [Sterling Software 1999], which breaks down "Managing Estates Services", into increasing levels of detail. The purpose of this diagram is to show the logical decomposition of activities, irrespective of management reporting structures.

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┌─────────────────────────────────────┐
│      Managing Estates Services       │
└─────────────────────────────────────┘
          ┌──────────────────────────────────────┐
          │      Managing Administration       + │
          └──────────────────────────────────────┘
          ┌──────────────────────────────────────┐
          │  Managing Electronic/Bio-Medical Eng │
          │                                    + │
          └──────────────────────────────────────┘
          ┌──────────────────────────────────────┐
          │     Managing Estates Information   + │
          └──────────────────────────────────────┘
          ┌──────────────────────────────────────┐
          │       Managing Fundraising         + │
          └──────────────────────────────────────┘
          ┌──────────────────────────────────────┐
          │    Managing Property Services      + │
          └──────────────────────────────────────┘
          ┌──────────────────────────────────────┐
          │        Managing Quality            + │
          └──────────────────────────────────────┘
```
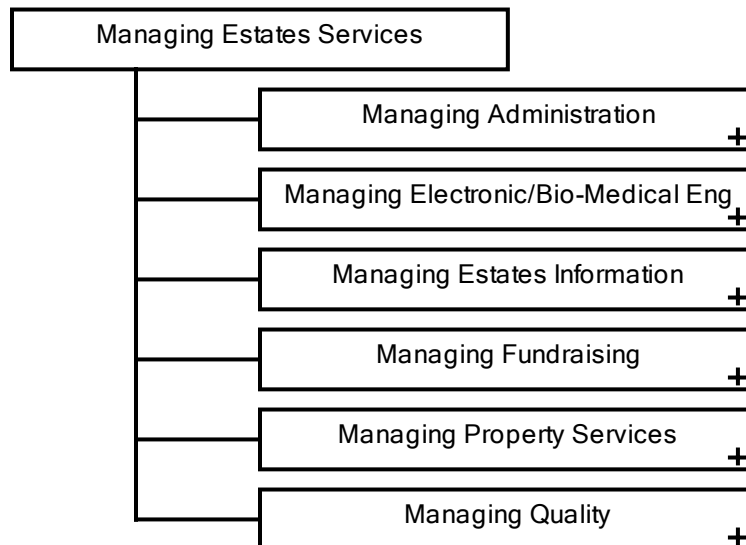
Figure 1. Managing Estate Services

The interviews proved that there is little process awareness and process thinking, among the FM professionals. There were many documents for describing the reporting structures, within the

hospital. However, there were no process maps. The general view within the senior management is that each hospital is unique, and it is not possible to tailor a base process map.

Another outcome of the interviews was that there was little service definition and scoping. For example if a manager were asked, "How many services do you manage and what is the purpose and scope of these services?" they would find it difficult to respond.

The interviews did not reveal much scope for improvements. Most middle managers thought that the performance of FM is adequate, with little room for improvements. However, one area for improvement, which was highlighted was the "response maintenance". This means the building maintenance processes, which respond to a customer calling about a fault. A "work flow diagram" [Sterling Software 1999] was used to capture this process.
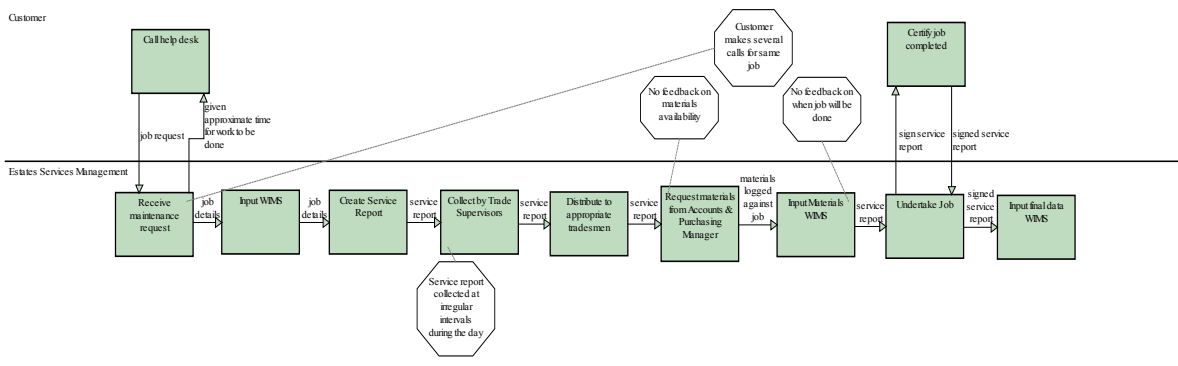

Figure 2. Response Maintenance Workflow Diagram

A workflow diagram (fig.2) shows the flow of work between processes and the organisational units to which the processes belong. It aids in identifying the areas where performance should be improved. The activities involving the customer are above the upper horizontal line, whilst activities involving the facilities unit are below that line. We can clearly see that in the current processes, information flow between the customer and the facilities unit occur only at the beginning and the end of the process. The boxes depict the activities. The octagons highlight the problem areas in the process. Goals can also be added on to the diagram, and demonstrated to show its effect on the highlighted problems. Areas of improvement were identified as: collection times for service reports which were irregular, and communication of delays due to unavailable materials to complainant.

The summary of the interview findings were that:
• The interviews were effective in familiarising the researchers with the organisation, its structure and some of the cultural values.

- The facilities managers view FM as a supporting infrastructure, which facilitates but is driven by the needs of the core business (i.e. health care).
- There is little process focus within the FM directorate and the support services to the health trust in general.
- There is extensive documentation. Through the interviews, the researchers were often referred to documents.
- Many process maps were developed during the interviews. However, these maps revealed little scope for improvements within the FM directorate. They revealed more about the need for re-structuring support services directorates, which was outside the scope of the research.

The SPICE FM Case Study

Following the interviews, the researchers carried out a pilot case study of the SPICE model, in FM. The scope of the study was level 2 processes, as shown in table 1. SPICE (at level 2) is project based, where-as FM is service based, so initially the terminology in the SPICE key processes and questionnaire were changed to suit FM. For example the key process "Brief and Scope of Work Management" was changed to "Managing Customer Requirements" and the word "project" was replaced with "service" throughout the questionnaire.

The scope of the study was limited to the activities of "Managing Electronic and Biomedical Engineering" as shown in figure 1. The objectives of the pilot case study were to:

- Identify any key processes which were not addressed by the framework in its applicability in FM;
- Test the effectiveness of the assessment mechanism, that is to check the appropriateness of the SPICE questionnaire and semi-structured interviews;
- Determine if the recommendations derived are meaningful to FM managers; and
- To provide the focus for the research project by helping to refine the data collection plans with respect to both the context of data and the procedures to be followed.

The assessment followed a similar pattern to that of the SPICE assessment, and highlighted a number of strengths. Documentation review revealed that clear organisational directives and supporting procedures that provided guidance for performing many of the process areas are defined within the SPICE model. It was identified that the capability to plan the work, track performance and manage subcontractors was strong as it was emphasised that the team consists of well-experienced and trained practitioners. It further identified the following as strengths: well defined processes for capturing work requirements; well established experiences of asset data base; outstanding work is clearly recorded; clearly defined methods for ordering goods; adequate training programmes; and collaboration and learning within the estates and other directorates.

However, the assessment also found a number of important weaknesses. The interviews revealed many different perceptions about the goals and critical success factors within the FM unit. Primarily this may be due to poor communication between senior management and practitioners performing the work, an issue clearly highlighted subsequently by interviewing staff individually. This resulted in confused priorities amongst staff. Although procedures existed, awareness of them was poor and many practitioners used their experience to improvise.

Although performance assessments were performed, issues of non-compliance were not followed up. Some members of staff did not understand the value of performance measurement. The audits were ineffective at ensuring compliance with organisational procedures. The interviews also revealed that many of the staff were aware of improvements that needed to be made. Although a mechanism for initiating change was available within the organisational procedures, it was not visible to the delivery team, nor driven by senior management. The team, therefore, made no attempt to address problems.

A particular issue of importance to senior management was that the organisation kept no record of the stock inventory. Consequently they sometimes did not have replacement parts for their maintenance activities. The middle manager believed this to be un-important, while the staff saw a clear need for an inventory. The senior manager was unaware of the situation, and decided to take immediate action, subsequent to the SPICE FM assessment.

Benefits from using SPICE in FM
SPICE was identified as a benefit to FM as a means of process improvement:
- It is an assessment mechanism based on facts and not perceptions;
- SPICE creates a rigorous and structured approach to FM organisational improvement thereby creating a strong process focus within FM;
- It is a means to achieve consistency and consensus on the way forward;
- It is a management initiative. It places the responsibility for process improvement with senior managers, rather than quality managers
- The framework identifies process strengths as well as weaknesses;
- The assessment time is relatively short, whilst only requiring the participation of the whole team for a briefing at the start of the assessment, and for a workshop to discuss the findings and determine improvement priorities;
- Though not part of the framework, the assessment process highlights cultural issues, as well as evaluating process management; and
- SPICE creates a strong platform for discussing improvements and capturing implementation plans.

Improvements Required in SPICE in FM applicability
The following were identified as improvements needed to the model based on the pilot study findings:
- There were some difficulties in understanding the terminology used in the questionnaire by some of the team members. Therefore it was agreed that some changes were needed to the SPICE FM questionnaire which will be used at the explanatory phase to be more meaningful;
- SPICE is still a research tool, rather than an industrial product, hence some documentation needs to be prepared to increase its potential;
- SPICE will be more beneficial if it is applied to all stages of FM processes;
- "Financial management" is identified as a key process and it was suggested that this should be added as a key process in level 2. This process was incorporated under service planning in the draft SPICE FM framework. In FM, it was identified that more emphasis should be given to financial initiatives and significant focus is required as it helps FM to keep a record of, and to achieve value for money;

- FM differentiates between "reactive" (e.g. response to a fault report) and "planned" (e.g. planed cleaning) services. SPICE FM needs to differentiate between these types of services.
- Further investigations are required to identify the level of maturity of FM organisations and process at other levels of the framework.

SUMMARY & DISCUSSION

The Structured Process Improvement for Construction Environment – Facilities Management (SPICE FM) project is looking to address incremental process improvement in the field of facilities management by translating research being carried out in the construction industry (SPICE, Balanced Scorecard, i2i) into a framework using modelling techniques, and applying this (initially within the healthcare facilities sector) to achieve a structured process improvement framework for facilities management. Applicability of SPICE in FM at the initial stages has illustrated that it does add value as a means of process improvement. The efficiency or influence of a given process is not always easy to demonstrate, SPICE's applicability in FM seeks to address this gap.

This paper provides the findings of an initial study, using SPICE FM. This study has revealed some of the strengths and weaknesses of the framework. Further investigations at an explanatory level are needed to strengthen the value of the SPICE approach, and in exploring how it could be linked with other popular process improvement techniques such as the Balanced Scorecard.

SPICE FM differentiates between process mapping and process improvement. Process mapping techniques are used during the project, as a tool for documenting and communicating processes and for highlighting some problem areas. However, they did not generate specific ideas for improvements.

SPICE FM focuses on institutionalisation of key processes. During the pilot SPICE FM case study several important improvement issues came to light. Process mapping techniques may be used to develop and communicate some new improved processes. Here process institutionalisation is the key factor in generating improvements. Process maps are tools, which may assist institutionalisation in certain cases.

REFERENCES

Barrett, P. (1995), *Facilities Management – Towards Best Practice.* Oxford: Blackwell Science.

Barrett, P. and Sexton, M. (1998), *Integrating to Innovate – Report for the Construction Industry Council.*

Becker, F. (1990), *The Total Workplace: Facilities Management and the Elastic Organisation.* New York: Van Nostrard Reinhold.

Bjork, B.C. (1994), The RATAS Project – an example of co-operation between industry and research toward computer integrated construction. *Journal of Computing in Civil Engineering.* ASCE 8 (4). Pp 401–419.

Caputo, K. (1998), *CMM Implementation Guide – Choreographing Software Process Improvement.* Reading, Massachusetts: Addison Wesley Longman Inc.

Davenport, T., (1993), *Process Innovation: Re-engineering Work through Information Technology,* Harvard Business School Press.

Deming, W.E. (1986), *"Out of the Crisis"* MIT Center for Advanced Engineering Study, Cambridge, Mass.

Feagin, J., Orum, A. and Sjoberg, G. (Eds). (1991), *A case for case study*, Chapel Hill, NC: University of North Carolina Press.

Imai, M. (1986), *"Kaizen: The Key to Japan's Competitive Success"*, Mc-Graw-Hill, New York.

Jick, T.D. (1979), Mixing qualitative and quantitative methods, Triangulation in action*, Administrative science*. 24. Pp.602-611.

Kagioglou, M. (1999). Process Protocols – Finding a common language for European Construction. *ECI News*. 1.

Kagioglou, M., Cooper, R., Aouad, G., Sexton, M., Hinks, J. and Sheath, D. (1998a), Cross-Industry learning: the development of a generic design and construction process based on stage/gate new product development processes found in the manufacturing industry. In Sivaloganathan, S. & Shahin, T.M.M. (Eds). (1998), *Engineering Design Conference '98*. Brunel University. Pp. 595-602. June 23-25.

Kagioglou, M., Cooper, R., Aouad, G., Hinks, J., Sexton, M. & Sheath, D. (1998b), *A Generic Guide to the Design and Construction Process Protocol.* The University of Salford.

Kagioglou, M., Cooper, R., Aouad, G., Hinks, J., Sexton, M. & Sheath, D. (1998c), *Final Report: Generic Design and Construction Process Protocol.* The University of Salford.

Nelson, M.L. and Baldry, D. (2000), Modelling Process Improvement in Facilities Management. In *Proceedings of the Bizarre Fruit Conference 2000, University of Salford*.

Nutt, B. (1998), "Moving Targets", *Facilities Management World*. 11. July – August.

Ould, M.A. (1995), "Business Processes: Modelling and Analysis for Re-engineering and Improvement", John Wiley & Sons.

Paulk, M. C. et al, (1993), *"Capability Maturity Model for Software, version 1",* Software Engineering Institute, Carnegie Mellon University, February

Paulk, M.C., Weber, C.V., Curtis, B., Chrissis, M. B. (1995) The Capability Maturity Model: Guidelines for Improving the Software Process, *Addison-Wesley*, Massachusett.

Saiedian, H., Kuzara, N. (1995), *"SEI Capability Maturity Model's Impact on Contractors",* IEEE Computer, January.

Sanvido, V. (1990), An integrated building Process Model. *CIC Technical Report: Pennsylvania State University*. (1).

Sarshar, M., Finnemore, M. and Haigh, R. (1999), SPICE: Is the Capability Maturity Model Applicable in The Construction Industry, *8^{th} International Conference on Durability of Building Materials and Components* (CIB W78), May 30 - June 3, Vancouver, Canada

Sarshar, M., Finnemore, M. and Haigh, R. (2000), " SPICE: A Business Process Diagnostics Tool for Construction Projects", Engineering, Construction & Architectural Management, June.

Stake, R. (1995), *The art of case research*, Newbury Park, CA: Sage publications.

Sterling Software. (1999), *Business Process Modelling With COOL:Biz – Student Guide*, Sterling Software, USA.

US Library of Congress, 1989, In Mole, T. and Taylor, F., 1992, Facility Management: Evolution or Revolution, In Barrett, P., (Ed.), 1993, *Facilities Management – Research Directions*, London: Surveyors Holdings Limited.

Walker, A. (1989). *Project Management in Construction*. Oxford: BSP Professional Books.

Yin, R.K. (1994), *Case Study Research: Design and Methods,* New Bury Park, London: Sage publications.

Zahran, S., (1998), "Software Process Improvement", Addison-Wesley.