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Modelling Business Processes in SMEs: An Approach For Non-Technical Staff

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ABSTRACT

A business process modelling technique has been designed for use, in an small-medium enterprise (SME) context, by general staff. It has evolved within the RAMESES method for risk assessment of systems change. A major factor in the development of the technique was the need to ensure that it was both "functional and usable": that is, it both fulfils the need to capture the business processes within an organisation and is accessible to staff who are not IT specialists and have not, necessarily, been exposed to other techniques of process modelling. The technique is more than a simple flow chart since it captures data that informs an organisation about its business processes and also allows layers of additional detail to be added in such a way that the impact of IT systems, staff competencies, resources etc can be evaluated. The case study results presented give a flavour of the "layers" and their potential usage.

INTRODUCTION

For many years systems developers have talked in terms of greenfield sites and have produced methods to use in such a context. The implicit assumption is that software development primarily takes place in virgin territory. However, as practitioners and researchers alike know, this is not a reflection of reality. The landscape is often composed of brownfield sites that need to account for the existing organisational context, software systems and business practices (Edwards and Mallalieu, 1999). An important and recent focus in the software engineering community has been in the recognition that, not only do systems have to fit into the existing (organisational) landscape, but that that landscape itself changes both independently of, and in response to, IT systems. The terms "co-design" or "co-evolution" have been coined to encompass this concept (Edwards et al, 1999). Once systems development moves away from greenfield sites, the task of planning and implementing change can become substantially more complex. A main aspect of the work reported here has been in devising appropriate techniques for capturing, representing and understanding the business activities within individual SMEs and the relationship between these and their IT systems. This is of practical importance to managers in SMEs since, for instance, when a new system is needed to support a particular business activity, the interconnections between many of the existing systems and business processes can act as a constraint on the range of solutions available to the organisation.

Understanding the impact of existing and planned systems in any organisation is complex, therefore those involved in both the analysis of business processes and requirements specification of systems need a range of appropriate tools to support them in their work. Our empirical research in the SME environment, since 1997, has focused on the manufacturing and distribution sectors and has shown them to have the following typical characteristics with respect to IT systems (Edwards and Mallalieu, 1999): their IT systems are business critical but they perceive IT systems as tools to support business activities; they rarely have IT departments and tend to rely on informal acquisition of IT knowledge. Therefore, for such organisations, IT systems specification, acquisition and evaluation is both important and difficult. Our research (undertaken within SMEs in N.E. England) has shown that for such organisations current IT systems usage and future IT systems requirements can be most effectively understood when viewed from a business process perspective. This paper presents one outcome of the work: a business process modelling technique, that has been developed and trialled within manufacturing SMEs. There are many process modelling techniques available (Ould, 1995; Giaglis, 2001) two of the most popular approaches are data flow diagramming (Yourdon, 1989) and IDEF (McGowan and Bohner, 1993). However, the terminology and complexity of usage associated with makes them inaccessible to the majority of SME personnel. Some simple techniques, based upon data flow diagramming have been proposed and used successfully within a business process context, for instance (Deeks et al, 1997; Tam et al, 2001) however, these do not support the richness of data that we required for our focus on systems change. The technique that has been developed during this research, Business Activity Modelling (BAM) technique, requires little in the way of training, is easily understood by SME personnel and has the benefit of explicitly identifying the areas in which IT systems impinge on business activity.

In Section 2 the requirements and instantiation of the Business Activity Modelling BAM) technique are discussed. Section 3 illustrates the usage of BAM in practice by focusing on some of the results from the field trials of the approach. We conclude by drawing out the main benefits of the technique and highlighting the future development of the approach.

THE BUSINESS ACTIVITY MODELLING TECHNIQUE

Within the research a number of existing process modelling techniques were trialled (for instance, DFDs, IDEF, RAD) since the research team were keen not to "reinvent the wheel" however, it was apparent that none of these effectively captured the range of data that was required. Therefore, the requirements of the end-users (the SME staff) and the research team were examined to determine an effective modelling approach. These requirement can be analysed under three headings: Acquisition of the Business Process, presentation of the business process and analysis of the business process. These are all discussed below (in Section 2.1). Once these requirements were clearly understood the modelling technique itself was developed (as explained in Section 2.2).

The Requirements for the Technique

The technique, "Business Activity Modelling (BAM)" has evolved in response to three main requirements in an SME environment: acquisition, presentation and analysis of the business process.

Acquisition of the Business Process

The main requirements in determining the type of process modelling that was required were the need to: (i) model the managers'

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perception of the business activity at a macro level, (ii) determine in detail the specific tasks undertaken within each business activity (micro level), (iii) map onto the business processes the tasks that are supported by IT systems and (iv) provide an approach that is accessible to all levels of employees within SMEs.

In addition to these requirements there were constraints imposed by the SME environment itself. For instance, managers in SMEs are (generally) unwilling to invest time in training personnel to use conventional process modelling techniques since the old adage "time is money" is foremost in their minds. Therefore, any process modelling technique that needs to be used throughout an SME (rather than by a few specialists) needs to be readily accessible with the minimum of training and support. Moreover, all employees hold a combination of tacit and explicit knowledge about their job. They are aware of what they need to receive to carry out their allotted tasks and what they do with the result upon completion. In practice, staff in SMEs readily know both the "reporting-to" and "responsibility for" structures and the individual task inputs and outputs of their activities. Staff are also aware (to some extent) of their role in relation to the overall business process and know explicitly the software they use in support of their tasks.

These requirements and constraints held the key to the development of an appropriate modelling technique.

Presentation of the Business Process

Even simple diagrams become cluttered when they are used to demonstrate the business activities within an organisation. There are two main features that can be used to overcome this problem: hierarchies and layers. Hierarchies are traditionally used in process modelling. The provision of a hierarchy within the modelling approach allows the user to both look at an overview of a business process (to gain an understanding of its overall topology) and then to focus on individual elements (to drill down to their pertinent details). Layers in the process model are akin to the layers used in geographical mapping, where basic maps can have features added, or removed dependent, on the requirements of the viewer (for instance, contours, roads, places of interest). In the case of the process maps in RAMESES these layers refer to system usage, and staff skill, for instance.

Analysis of the Business Process

The analysis of the business process is inherently bound up with the presentation of the data. To have a thorough understanding of the process it is necessary to have access to organisational data (the "layers") so that the process can be examined as appropriate.

The Instantiation of the Technique

This section reflects the three requirements for a business process model identified above and provides and explanation of how each requirement is fulfilled.

Acquisition of the Business Process

The users of the technique complete a number of simple workpacks so that the required details can be gathered to enable the construction of the process models. There are two sets of workpacks: one which gathers the macro level data ("organisational mapping"), the other gathers the micro level data ("task trail").

At the macro level in the organisation an individual (with sufficient authority) is designated to be the co-ordinator who oversees the data collection required. S/he then liaises with the senior managers to acquire details of their area(s) of responsibility along with who they report to. A senior manager may have more than one area of responsibility and therefore may be entered several times in the workpack (as shown in the Figure 1 below). The senior managers then complete workpacks for each of their areas of responsibility. Each of these identifies: the business activities within the area, who has responsibility for each, and to whom they report. This allows the depth and breadth of the management hierarchy to be identified. Typically within an SME an individual may have responsibility for more than one activity and therefore may be entered several times in the workpack table. Where there is interest in the IT supporting the business then this is also recorded against the activity. This is illustrated in Figure 1.

Figure 1: Example of data entry for macro level data (for reporting structure)

Senior Manager	Area of Responsibility	Reports To:
Germaine English	Sales	Jo German
Germaine English	Marketing	Jo German
…		

Senior Manager Name: Germaine English		Area of Responsibility: Sales	
Activity	IT support	Staff Member with responsibility:	Staff Member Reports To:
Quotation for Customer	PerfectQuotes	Samantha Scott	Sebastian Welsh
Technical support	SuperCAD	Terry French	Samantha Scott
….			

This data acquisition approach reflects the managers' understanding of the organisation's activities, the software in use and its impact. From this, the macro business activity model is constructed. This is done simply by following the "reporting to" paths to establish the unique organisational hierarchy. Where an individual has multiple roles these are used as secondary data to ensure the correct pathway is established. The subsection *"presentation of the business process"* shows how these models are represented diagrammatically.

The nominated coordinator defines the boundary of the enquiry from the macro level model. Then, for each activity within the boundary (at the micro level), the staff member with responsibility is required to: identify the business processes within his/her area, list the staff members active within these processes, and mark the initial task within each process. At this stage the modelling moves away from organisational hierarchies (and functional areas) to an analysis with a processual focus and the task trailing of a process can begin. This is a critical feature of the approach, much of the analysis that can be done to evaluate the organisation and its reliance on IT systems is dependent on the information collected here. The micro level business activity model requires individual task data to be recorded on the relevant workpack. This data includes: the inputs to the task, the description of the task, and the outputs of the task. Additional information is also collected so that a profile can be constructed of : how the input and output data are provided, by whom, and whether any IT is used to support the task. In this way the business process can be built from its task level components reflecting operational practice. Figure 2 shows sample data for a business process and some detailed data from the subsequent task trail.

The macro and micro level data sets contain the primary data for the construction of business activity models. The secondary data collected at the micro level provide additional richness in understanding the problem domain. This data includes: individual evaluations of the IT systems in support of tasks, users IT education, experience, and training.

Presentation of the Business Process

The textual data is transformed into diagrammatic business activity models to enable managers to view, discuss and analyse their processes more effectively. The notation used for this is similar to many other process modelling techniques:

- annotated boxes represent business activities and tasks,
- annotated arrows indicate the type of data flowing and the sequence of tasks.

Figure 2: Example personnel and tasks within a business process, and subsequent task data

Business Process Component Name: Customer Order Placement

Named Staff with overall responsibility for the component: Sebastian Welsh

Task	First Task	Employee's Name
Receive Customer Enquiries	4	Samantha Scott
Quotations		Samantha Scott
Costing		Sebastian Welsh
Customer service		Samantha Scott
…		

Process Name:	**Customer Enquiries**

Task No.:	CE1	**Task name:**	Quotations
Task Input:	Customer enquiry details		
Task description:	Assess and price job details to produce quotation		
Task output:	Customer quotation		
Input description:	Completed customer enquiry form		
Input from:			
Person	Samantha Scott		
Role	Customer Service Representative		
Department	Sales		

Input Received Is Generated: ☐ Electronically ☐ Manually ☑

Output sent to:

Person:	Sebastian Welsh
Role:	Sales Manager
Department:	Sales

Output Is Produced: ☐ Electronically ☑ Manually ☐

Hierarchical views are developed where appropriate so that the business activity can be broken down until "atomic" tasks are achieved. Where the technique diverges from the norm is in the use of additional information to enhance and enrich understanding. For instance, layers of colour show IT systems impact within processes and numbers of users are recorded against these IT systems as an indication of the degree of usage. Figure 3 shows an example of a **partial** business activity at the model micro level. This example shows the "IT systems impact" layer. It is worth noting at this point that, unlike this snmall scale example, the task trails are typically processual in nature and define business processes that cut across existing functional boundaries. This provides a mapping of the business that is often revelationary to the organisation.

Analysis of the Business Process

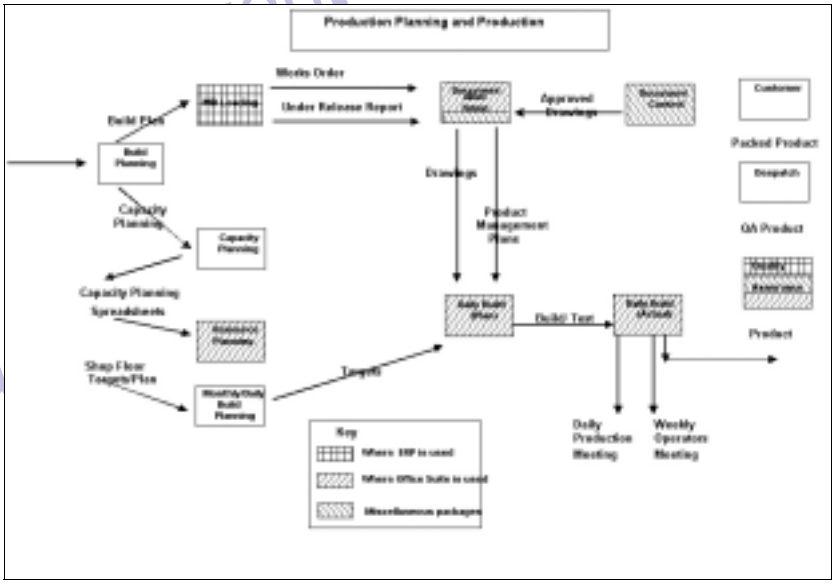
This approach results in a variety of business activity models: each is a representation of a different view of organisational data. The analysis of this data is undertaken by comparing and contrasting pairs of representations. In our fieldwork the most common sets of comparisons were:

- The current situation: perception versus reality.
- Macro level versus micro level.
- Effectiveness of current business operations: for instance, identification of bottlenecks.
- Employee analysis: for instance assessment of workload.
- Employee analysis: secondary factors emerging from the layer analysis, including skills profile, potential champions of change.
- Effectiveness of IT Systems support across process and within functions.

USAGE OF BAM IN PRACTICE: A CASE STUDY ILLUSTRATION

The case study organisation discussed in this section was studied, in detail, over a six month period. This section focuses on those aspects relevant to business activity modelling. To put this in perspective some background is given. The company employs approximately 190 people in the manufacture and servicing of power supplies for the electronics industry. The company was concerned about the perceived failure of an Enterprise Resource Planning (ERP) implementation. The aim of the study was to determine whether user acceptance could be improved and to identify any potential enhancements that could be implemented. The major stakeholders in this project were the senior management team and a key user group. The business development manager responsible for the implementation of the system led the project as the nominated co-ordinator. The ERP system had been under incremental implementation for 18 months but had suffered from declining user morale and was still unable to fulfil some of the fundamental requirements of the project. The

Figure 3: Partial task trail, with IT systems usage identified



organisation had a good IT department, but it was experiencing difficulties in supporting the project because of problems with the system supplier's support network. The RAMESES assessment was viewed as fundamental to the future of the system, which represented a major organisational investment in the region of £360,000 (over $500,000).

To assess the impact of the ERP system throughout the organisation, and to determine the nature of user dissatisfaction, the project team identified a boundary for investigation following the construction of macro level models. Thereafter a selection of business process models and maps were developed as an aid to understanding the 'as is' position of the organisation.

A number of BAMs were constructed for the manufacturing functions of the organisation. These revealed differences between the perceived and actual usage of the ERP system. The perception of the head of operations was that the system was used throughout the manufacturing process. However, the results of the task trail as shown in Figure 3 above indicates localised and varied software usage within the manufacturing process. Additional analysis highlighted manufacturing systems support as a key factor in the reported user dissatisfaction: this was fundamentally related to the inability of the system to support standard operating procedures. Through the task trailing it was revealed that high degree of innovative use of the ERP system and other software was enabling the business to function as required. An example of the findings is summarised in Table 1 which highlights this dissonance between reality and perception, and the impact of the new (ERP) system on production planning. The expectation was that the ERP system was being used effectively across all tasks (except production control which was expected to be carried out manually). In practice what was discovered was that there was patchy use of the system, with significant use of the office suite to develop localised software support for business activity, and two areas remaining entirely manual in operation ("labour" and "build plan" both of which were resource intensive).

CONCLUSION

Business activity maps and tasks trails provides SMEs with an approach to process modelling that can be adopted without the need for extensive training. In practice the research team have used the approach in five organisations, co-ordinated its usage in another two and provided initial training for co-ordinators who have independently applied the process in another three companies. The feedback from this usage has revealed that the critical components in its successful application are:

- The use of one trained co-ordinator: this training has been carried out by the researchers within a one-hour session and followed up with (limited) advice in the early stages of the application of the approach.
- A "top down" approach: to allow the co-ordinator to gather the data at the macro levels from the appropriate managers and use this to set the bounds for the micro level data collection.
- Access to the management team: so that the co-ordinator can distribute the workpacks for the data collection.
- Access to the personnel within the boundary of investigation: so that the co-ordinator can distribute the workpacks for the data collection.
- Analysis of the resultant data by either the co-ordinator or a small group to draft the process models and undertake the analysis of the layers. For this to be done accurately the time needs to be made available by the organisation for this activity.

The components highlighted above indicate a "top-down" sequential approach. However, we have found in practice that the data gathering can be undertaken in a piece-meal fashion. With the proviso that the co-ordinator manages the process carefully and is aware of "missing components". This enables the maps to be created and enhanced as the data becomes available: in this way gaps and inconsistencies are demonstrated and the co-ordinator can ensure that either the required data is then collected, or highlights to management a breakdown in a process in the organisation. Practice has shown that the maps and models are frequently developed in this iterative manner.

We believe that the two main advantages of the BAM technique are its accessibility to non-technical staff in SMEs, and the flexibility that the technique offers in enabling managers to evaluate and appraise their business processes from a range of perspectives: for instance, effectiveness, staff skills/competencies, software support. The technique is currently one component within the RAMESES method and has partial software support. However, the next stage of development of the technique is to provide a fully functional software tool to support the users throughout the mapping/modelling process and to trial the approach within a wider range of companies. Without software support for the technique organisations are unlikely to make full use of the data collected since, although the maps can be manually constructed quite simply, the addition of layers of supplementary data that can be superimposed or reviewed in associated reports and charts is time-consuming.

Table 1: Summary of IT support in production planning

	Management Perception of IT Usage versus Actual IT Usage. No of tasks supported:		
	by ERP System: Expected v actual	by Office System: Expected v actual	purely manually: Expected v actual
Forecasting	1 v 0	0 v 2	
Resource Planning	1 v 0	0 v 2	
Materials Requirement Build	1 v 2		
Labour	1 v 0		0 v 4
Capacity	1 v 3		
Build Plan	1 v 0		0 v 5
Production Control		0 v 2	1 v 0
Release Works Orders	1 v 1		
Reports	1v 0	0 v 1	

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