Monitoring and predicting the rate of team system development

N. BYER and R. H. WESTON

Abstract. Semi-formal models of two aspects of team systems are developed, which relate to teamworking development and task realization. Related natural characteristic states and state transitions are also described. This provides a rational basis of argument that these two aspects of team system development are naturally linked and that an understanding of either or both will naturally facilitate the monitoring of team progress and can assist planning and prediction of team activities. This argument is tested in relation to four project teams with a similar complex task assigned. The case study findings partially support the argument but also illustrate how other factors can significantly deviate a team from predicted state behaviours.

1. Introduction

Teams are everywhere. In the professional arena, we have project teams, product teams, quality teams and management teams. Teams are important and exist in both professional and personal lives. Unfortunately, not every team is successful, not every team is effective. In fact, one of the great frustrations is the failure of teams to function smoothly and to run effectively (Parker 1990).

Managing a team is fundamentally a matter of coping with a complex system. Syer and Connolly (1996) describes a ‘team system’ as a group of people who constitute a system of interrelated entities and whose members share a common goal. A team can be characterized as a system with inputs, outputs, structures, processes and circular causality (Schermerhorn et al. 1995). Therefore in order to gain a real understanding of teams, one must first understand the characteristic components a team system such as team system processes and structures. Two such processes refer to teamworking development and task realization.

Woodcock (1979) states that any team has two prime areas of concern, namely: (1) teamworking development, ‘the way the team plays’; and (2) task realization, ‘the direction of individual skills towards a united effort needed to complete tasks and attain goals’. Teamworking development involves ‘taking care of the team members’ and is centred on team behaviour, roles, work assignment, communication and so forth (Woodcock 1979, Stickley 1993). While task realization is about ‘getting the job done’. Task realization should lead to attainment of goals and completion of the purpose for which the team was developed (Woodcock 1979, Stickley 1993).

Since Woodcock’s publication in 1979, many authors have purported models that support his view that teams will concurrently carry out sub-processes concerned with (1) and (2). One such model is Gladstein’s (1984) Model of Group Behaviour (see figure 1). Figure 1 identifies two main team system processes, namely: teamworking development (team processes) and task realization (team task). Gladstein’s model of group behaviour, like others, has distinguished between teamworking development (which Gladstein termed team processes) and task realization (which Gladstein termed team task) (Woodcock 1979, Hunter and Bailey 1992, Schermerhorn 1995, Syer and Connolly 1996, Bowers et al. 1997, Marks et al. 2001). Task realization is critical to team effectiveness and depends heavily on members’ technical skills and expertise as well as teamworking development that directs, aligns and monitors task work (Marks et al. 2001). Typical activities centred on task realization are directly concerned with generating outputs, such as product requirements specifications, product designs and physical realisations of products. While teamworking development activities are geared towards defining and implementing improved means of achieving tasks, such as by some appropriate distribution of roles and responsibilities amongst team members, and by developing member and team competences that lead to improved interactivity within the team and between the team and its environment.
This paper is focused on these two prime areas of concern about team systems: teamworking development and task realization. It aims to (1) identify and discuss existing teamworking development and task realization models with a view to develop a deeper understanding of the processes that occur during team system operation; and (2) develop notions about teamworking development and task realization processes and how these processes may be inter-related. Based on relevant literature, this paper characterises aspects of teamworking development and task realization process threads into organized sets of activities that typically are resourced by a team so as to add value to the team and its environment. This is achieved by defining achievable states and state transitions associated with teamworking development and task realization; so as to enable the monitoring of those states and state transitions, and thereby the extent to which a team has moved towards a mature state. A proposed approach to monitoring team progress is tested on four case study teams and the results obtained are reported. Implications arising are considered with respect to related team system performance measurement issues, and whether those measurements might best be linked to teamworking development, task realization or both.

2. Role of teams in manufacturing enterprises

Figure 2 is a generalized, abstract and very simple ‘functional’ representation of a typical manufacturing enterprise (ME). There may be multiple instances of the functional units depicted (such as the existence of a number of manufacturing plants) and the functional units may be distributed around the globe. Therefore at a very abstract level MEs can be loosely characterized as some combination of business, design and manufacturing units which operate in an integrated manner to add value to materials, components and systems (received from suppliers) in such a manner that the ME can supply products to customers at a profit.

Weston (2003) explains that in general ME processes such as business, engineering and production processes (see figure 2) comprise order sets of activities. These processes are executed by a set of functional entities (Kosanke 1996, Vernadat 1996). A functional entity is any resource inside or outside the enterprise.
capable of executing basic functional operations (Vernadat 1996). Examples of functional entities within an enterprise are:

- Machines;
- applications, i.e. software packages;
- humans or groups of humans (such as groups and teams).

Therefore within a manufacturing enterprise, teams can be deployed to execute business, engineering and production processes and activities. Figure 3 is an illustration of the use of teams in MEs.

As described earlier, team systems are complex. Team systems constitute a combination of human resources with a variety of personalities, skills, competences, behaviours and experience. Within a manufacturing enterprise, these complex systems resource ‘business’, ‘engineering’ and ‘production’ activities. There are many different types of teams that can be used to resource a wide variety of business processes, figure 3 identifies just three types of teams that can be deployed within an engineer-to-order ME. Therefore to enable the successful deployment of team systems within a manufacturing enterprise there are major issues that need to be addressed. Research with regard to the engineering of team systems has identified major problems that must be overcome to utilize ME teams more effectively.

Concurrently, there has also been a proliferation of research addressing the difficulties of successfully utilizing teams. Team experts have advanced a wide spectrum of theories, tools and techniques for designing, developing and implementing teams. These researchers have advanced and tested novel approaches for team role allocation (Bales 1950, Belbin 1981, Margerison and McCann 1990, Myers and McCauley 1992); teamworking development such as the forming–storming–norming–performing (FSNP) model (Woodcock 1979, Hardingham and Royal 1994, Foster et al. 1996, Syer and Connolly 1996, Holpp 1999); team effectiveness (Nieva et al. 1978, Shea and Guzzo 1987,

![Figure 2. Simple ‘functional’ view of a manufacturing enterprise (ME).](image)

![Figure 3. Team systems resourcing ‘doing’ processes in an engineer-to-order manufacturing enterprise.](image)
Despite the existence of a wide variety of the tools and techniques available in academia for obtaining maximum benefits from teams, the practical deployment of team-based approaches in industrial settings fail to produce the desired results. Therefore the practical deployment of teams and team-based approaches in industry presents complex problems and require innovative solutions.

With an intention of providing possible solutions, this paper aims to develop a better, more coherent understanding of teamworking development and task realization processes and the factors that impact on these processes. This paper also seeks to explain and test the existence of a hypothesized link between teamworking development stages and task realisation stages.

3. Teamworking development process thread

Teamworking development has been described as the pattern of change, growth or progression of a team to more mature states as team members interacts across multiple contexts to achieve a task over time (Gluesing et al. 2002). Teamworking development processes describe the 'way a team plays together' to achieve tasks (Scholtes 1988). Such processes are also needed to deal with the internal (to the team) pressures that arise. Those processes are instrumental in determining behavioural characteristics of a team as it progresses through its lifetime. Scholtes (1988) states that teamworking processes are as important as the task realization processes carried out by a team in response to external influences as they realise assigned goals and objectives. When teamworking processes run smoothly, team members can concentrate on task realization. However, when a team fails to build effective, efficient and timely relationships among its members, it will typically waste time on struggles for control and endless discussions leading nowhere (Scholtes 1988).

There is general agreement that teams progress through different stages of teamworking development (Woodcock 1979, Scholtes 1988, Katzenbach and Smith 1993, Scott and Walker 1995, Foster et al. 1996, Robbins and Finley 1996, Syer and Connolly 1996, Thompson et al. 1997, Holpp 1999, Caracciolo 2000). These stages are defined within the FSNP model of teamworking development from Tuckman and Jensen (1977). During each of these stages, characteristic patterns of events and observations give rise to characteristic challenges and responses in the form of developmental behaviours within the team system. Each of these four stages has been further detailed below in table 1. This information gathered to describe these stages was obtained from the works of Caracciolo (2000), Dyer (1994), Foster et al. (1996), Hayes (2002), Holpp (1999), Kur (1996), McGourty et al. (2001), Moxon (1993), Scholtes (1988), Thompson et al. (1997), Tuckman (1977) and Woodcock (1979).

During the forming stage team members achieve a transition from individual status to member status. Characteristic forming activities centre on introduction, orientation and initiation sub-processes. Characteristic storming activities clarify relationships between team members and enable a team to focus on interpersonal issues. During its norming stage a team develops systematic and synergistic approaches to working, typically developing and formally describing operating guidelines for that purpose. During the performing stage, teams have now developed team competencies needed to achieve task development activities in an effective and timely manner, as a consequence of having previously developed appropriate levels of trust, energy (or spirit), creativity and innovation (Kur 1996).

As a team becomes increasingly effective, the procedures it adopts and the characteristics it displays will change (Woodcock 1979). Team efficiency increases as teamworking processes transforms from a group of individuals to a successful functioning unit. Gluesing et al. (2002) described this transformation in the form of table 2.

Managers operating within the host environment of teams, as well as team leaders and team members, will in general require teams to progress to the performing stage as quickly as possible and then to remain at this stage for as long as required (Kur 1996). This assumes that team maturation is an idealized state a team will seek to achieve and sustain. Also commonly assumed is that the rate at which a typical team progresses in order to reach the performing stage (i.e. the rate of transition between forming to storming, storming to norming and norming to performing) will influence team functioning and the quality of the final output. However, each stage of team development appears to be vital, so that neglecting any of the activities involved in team development can be expected to adversely affect a team’s growth and the quality of its outcomes.

4. Task realization process thread

Task realization is about actually getting the job done and should lead to goal and objective attainment, and thereby completion of the purpose for which the team was formed and developed. Syer et al. (1996) description of teams focuses on a progression through four main stages of task realization, namely: recognition,
understanding, decision and implementation\footnote{Syer also describes a fifth, completion stage of task realization that concerns: follow up assessment processes, empowerment of process owners and release of authority. However, this paper focuses only on the first four stages of the Syer task life cycle.}. Syer \textit{et al.} (1996) characterized each task realization stage as follows.

4.1. Stage 1: recognition

During the recognition stage of task progression, a team makes initial contact with the situation. Early impressions formed by the team may determine the ultimate success or failure of ensuing teamworking development and task realization processes. The
The essence of the recognition stage of task realization is one of identifying circumstances – rather than making a behavioural response. From identification sub-processes (i.e. ordered sets of value adding activities carried out during the task recognition stage) a recognition or understanding of aspects of the team’s purpose will be developed, as will an understanding of the necessary tasks required to fulfil the team’s purpose bearing in mind the team’s particular operating environment and constraints.

4.2. Stage 2: understanding

At the understanding stage of task progression typically a team will carry out three main types of task, namely: (1) making certain that key issues identified at ‘stage 1’ are really the ones that need to be addressed; (2) collecting data to clarify and amplify the nature and impacts of the team’s operating environment and constraints; and (3) preparing a data analysis that will show how team responses might be made.

4.3. Stage 3: decision

If performed effectively it is likely that the understanding life phase will have included use of a framework for making decisions. This should yield understandings about possible options and initial criteria for success. The decision stage of the task life cycle should finalize criteria for success, align these criteria to initial objectives, generate options for action and decide upon the best course for action.

4.4. Stage 4: implementation

At the implementation stage of task progression the team should have a focus on project management. Thereby it should organize and realize the design, development and implementation of needed task processes (i.e. needed elemental task realising activities over time), thereby translating ideas into successful results.

5. Hypothesis definition

From the literature described in Sections 3 and 4, apparently there are two distinctive ways of viewing the progress of a team. The former approach emphasizes the importance of achieving satisfactory development of teamworking. The latter highlight the importance of satisfactory achievement of the task goals. The former approach focuses on how the team must organize and progressively develop itself, so that its structures, processes and behaviours reach a state where the team can successfully function as a unit with all needed competencies to achieve the team’s purpose. The latter approach focuses on what the team must actually do.

Teams, like organizations are very complex systems and are naturally dynamic in nature. As such team systems can be characterized by a number of inter-dependent and inter-related entities which may include tasks to perform, roles to resource, functional and behavioural processes to control and monitor, structures to develop and performance to manage and maintain. However, the co-ordination and co-dependencies among team system entities is not without difficulty. The challenge, however, is to be more effective in the design and building of new team systems, as well as in the operation and maintenance support of those team systems already in being. The literature shows that MEs deploy various forms of human team in a variety of roles. However, at present MEs have limited support in terms of systemic concepts, methods and tools with respect to the life cycle engineering of such teams. This research aims to address key aspects of this deficiency.

Based on the above understanding, the study seeks to improve provide a more coherent and holistic understanding of team systems operation with respect to their teamworking development and task realisation activities, in order to reduce and if possible eliminate some of the challenges that plagued team systems operation and adversely influence team system performance.

As such the following hypothesis is proposed:

**H1:** The stages and stage transitions of teamworking development are synchronous (to some extent) to the stages and stage transitions of task realization.

The existence of this synchronicity might usefully be deployed in the form of a reference model of teamworking development and task realisation, which can be used to improve understandings of teams operating within MEs. For example enterprise designers might use knowledge about or measurements taken in respect to one set of stages and stage transitions to infer knowledge or information about the other set, thereby realizing a means of monitoring, measuring and managing the progress and performance of a project team.

This hypothesis is advanced in view of the following assumptions:
(1) All needed understandings about ME project teams, such as team processes, team behaviours; cannot be wholly developed in advance of team working (such as when a team is first commissioned) unless the team is required to perform a wholly known job under wholly known and stable conditions. For the large majority of projects team working in an ME those conditions will not be satisfied.

(2) Consequent upon project teams (and their constituent team members and their leaders) will need to progress their individual and collective working, in order to achieve teamwork development requirements that match the task realization requirements they uncover during the various stages of task progression.

(3) Activities performed by a team to achieve transitions from one stage of teamworking development to the next will be driven (at least partially) by task realization requirements uncovered at each stage of task progression.

In seeking further insights into the hypothesized coupling between the two sets of states and state transitions, characteristics of common task realization and teamwork development activities, have been analysed by the authors and recorded into table 4. The second column of this table illustrates some commonality of purpose observed at different stages of teamworking development and task realization. Also indicated in this column are likely prevailing conditions during each stage. The fifth and sixth columns of table 4 provide examples of general activities that need to be resourced so that the stated purpose of each stage can be achieved. The fifth column provides teamworking development based examples of those general activities, whereas examples in the sixth column are focused on task realization.

Table 4 gives some theoretical backing to the hypothesis that causal links will normally exist between states and state transitions found in teamworking development and task realization and that consequently we might predict some degree of synchronism in teamworking and task progression. To test this hypothesis and the connected idea that knowledge about such a link might enable simplified measurement and management of team progress, the authors used actual data about four project teams to observe (or otherwise) whether synchronous teamworking development and task realization is likely to occur in practice.

6. Test cases

This research is geared towards teams within a manufacturing environment, i.e. the population of interest is teams at work within the industry. However, because of the difficulty of collecting workplace data, it was advantageous to find an alternative data source. As such student teams were observed during these case studies and were used as the data source in an ‘artificial setting’.

Industry workplace samples are obviously more representative of the population of interest than student samples, but when workplace samples are unavailable or when levels of involvement are unrealistic for a workplace commitment a student sample provides a reasonable alternative (Zolin et al. 2002). University students are a research population that is widely used by researchers because students are close at hand and are also readily available in large numbers (Babbie 1988).

The test cases described subsequently used student teams as the data source in an ‘artificial setting’. Because this environment was an artificial setting, the researchers had the advantage of greater control of the subject’s environment. However, this added control was offset by a corresponding loss in realism. For example, industry teams are formed to bring together diverse skills that are necessary for completion of the task, which is not possible with student teams (Poppleton and Robinson 1994).

<table>
<thead>
<tr>
<th>Task realisation stage</th>
<th>Characteristic activities of each stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1: recognition</td>
<td>Identify the situation; identify boundaries; identify input/output; identify ideal function and identify customer.</td>
</tr>
<tr>
<td>Stage 2: understanding</td>
<td>Gather information about content, process, noise and error states; understand links between system and its ecology (of which the system is a part); generate ideas, new processes and new solutions; and identify root causes of problems.</td>
</tr>
<tr>
<td>Stage 3: decision</td>
<td>Establish ways of eliminating problems; plan changes; define robust and stable processes; improving processes; re-engineer processes; choose designs; and decide on strategy.</td>
</tr>
<tr>
<td>Stage 4: implementation</td>
<td>Plan implementation; replace processes as needed; run experiments; refine products as required; train people, machines and software; consult concerned parties; and generate team products.</td>
</tr>
</tbody>
</table>
## Table 4. Teamworking development life cycle versus task realization life cycle.

<table>
<thead>
<tr>
<th>Teamworking development stage</th>
<th>Commonality of purpose and prevailing situation</th>
<th>Task realization stage</th>
<th>General activities needed to achieve stated purpose of each stages</th>
</tr>
</thead>
</table>
| Forming                      | Determine who fits where? Team members are unsure about the task and its demands on them. Team members are unsure about their roles and responsibilities. There is confusion with regard to the initial and needed structural organization and operating procedures. | Recognition           | The team is formed. Team roles are established, needed interpersonal skills identified and the team warms up.  
The essence of this stage is identification of the circumstances; not make a response. It is to identify and define task requirements pertaining to a particular situation and purpose. |
| Storming                     | Decide how things should work? Chaos and confusion may ensue within the team. Discussion and disagreement is often caused as roles are being decided. The team reviews its operating procedures. | Understanding         | Widen and deepen understanding of the task to determine how the team must operate and be organized to achieve the task within defined boundaries and constraints.  
Observe, generate information and collect data. Analyse data. |
| Norming                      | Achieving co-ordination. The team will establish norms and set boundaries and ground rules that facilitate co-ordination. | Decision              | Establish task realization and coordination processes. The team agrees on a decision-making process that will vary according to the nature of decisions made.  
The team aligns decisions with the initial objectives, generates options for action, and decides on the best course for action. Since decisions involve choice from different options, prioritisation criteria, both quantitative and qualitative, have to be established. |
| Performing                   | Realising goals, the team works together towards common goals, productivity and team development. | Implementation        | The team is now involved in project management (scheduling, co-ordination, monitoring and controlling) as well as task realization.  
Design the strategy, the team designs, plans and develops the actual strategy. The team also pilots the implementation of strategy and implements the strategy. |

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6.1. Background to the test cases

Initial data used to test the hypothesis that teamwork-development and task realization are essentially synchronous was elicited from observations about the behaviours of four project teams. The four teams shared a common aim; namely to create process oriented models of a ME and to utilise those models to predict enterprise responses to changing requirements and environmental conditions. The four project teams conducted this work as part of a course module offered for masters and undergraduate programmes at Loughborough University. Participating teams had to accomplish the following:

- Invent their own manufacturing organization; complete with a detailed description of its constituent business processes and activities.
- Allocate human and technical resources with competences and capacities needed to achieve specified business processes and activities of the fictitious manufacturing organization.
- Use qualitative and quantitative systems modelling methods to create simulation models of the specified business processes, in order to predict and analyse the impact of possible process changes.

The data was observed in respect to 19 students working in four teams, each with four or five members. Fourteen of these students were postgraduates and formed three postgraduate teams. The remaining five became an undergraduate team.

The undergraduate team comprised members with similar cultural backgrounds, who knew each other prior to project work. This team composition had marked differences from that of the other teams. This could not be avoided because their class schedule was unlike that of the other students and as such their possible project working times did not coincide with that of the other students. The undergraduate team also had approximately half the timetable time to devote to the project, compared to the other three groups. Team member selection within the other three teams was based on a mix of experience, cultural background and gender distribution, and was independent of any personality-based test. This was to replicate team selection conditions that exist in many organisations where teams are not allowed the luxury of choosing its members based on best-fit personality but rather from members that are technically competent and available at the time of the project.

The behaviour of each team system was monitored and recorded during the lifespan of the project in order to identify and document the following:

- Length of time spent on each stage of task realization.
- Behaviours, events and activities associated with each task realization stage.
- Times of transitions from one task realization stage to another and corresponding behaviours, events or activities exhibited.
- Length of time spent on each stage of teamworking development.
- Behaviours, events and activities associated with each stage of teamworking development.
- Times of transitions from one teamworking development stage to another and the corresponding behaviours, events or activities exhibited.

6.2. Development of general reference models of task realization and teamworking progression

Prior to analysing the actual progress made by the case study teams, general predictions were made about expected task realization progress. The predictions made were based on theories outlined in earlier sections of this paper and are summarized into table 5. The idea here was to develop a general reference model to inform task progression measurement. This generic reference model can position actual task realization activities relative to general task decomposition and execution, and thereby for any specific team can help determine: (1) the current state (or stage of progress) of task realization; and (2) the occurrence of state transitions between stages of task realization.

Similarly before analysing the actual progress of the case study teams, general predictions were made about the teamworking development progress. Again prediction was based on theories described in earlier sections of this paper and were entered into table 6, so as to provide a generic reference model of teamworking development. The purpose of this general reference model was to help determine: (1) current state (or stage of progress) of teamworking development; and (2) the occurrence of state transitions between stages of teamworking development.

It follows that tables 5 and 6 were conceived to act as ‘standards’ against which the progress of the four case study teams could be observed and measured. To complement the use of this framework for progress observation and measurement, separate means of measuring the actual performance of teams, with respect to results delivered, were also developed for use at specific times during project execution.
Table 5. General reference model of task progression, developed to inform task progression measurement.

<table>
<thead>
<tr>
<th>Task realization stage</th>
<th>Expected task decomposition and task realization activities</th>
<th>Expected task oriented activities needed to realize transition to next task realization stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition</td>
<td>Identification of project tasks; task definition; project goals, project constraints, performance metrics</td>
<td>Identification of the team’s objectives. Development of an action plan. Allocation of jobs within the team (functional roles). Initial task decomposition. Initial individual task assignment.</td>
</tr>
<tr>
<td>Understanding</td>
<td>Collection of information about different types of product and their manufacturing processes. Uses of information to generate clear understandings about the manufacturing enterprises, departmental entities; business processes and enterprise activities, required to realize the manufacture of each of the products options being considered.</td>
<td>Primary data collection needs to be finished. Team needs all necessary information to decide how to proceed. Team needs to develop a revised action plan.</td>
</tr>
<tr>
<td>Decision</td>
<td>Team chooses the product and sets about inventing their own manufacturing organisation complete with a detained description of its constituent business processes and activities. Team determines how to allocate human and technical resources to these business processes and enterprise activities.</td>
<td>Key decisions have been made and discusses the reason for its choice to ensure consensus. A schedule of work is developed which identifies the resources to-be committed, timescales, milestones, deliverables. Identification of measures of success. Identification of expected benefits.</td>
</tr>
<tr>
<td>Implementation</td>
<td>Uses qualitative and quantitative modelling methods to create simulation models of the ‘as is’ and ‘to be’ processes. Monitors it progress with respect to schedule and original goals developed.</td>
<td>Each team was given similar deadlines for submission of both the interim and final reports. These dates ensure that the projects do not continue indefinitely. The project teams were given definite start and finish dates.</td>
</tr>
</tbody>
</table>
### Table 6. General reference model of teamworking progression, developed to inform teamworking progression measurement.

<table>
<thead>
<tr>
<th>Teamworking development stage</th>
<th>Teamworking activities and behaviours anticipated at each developmental stage</th>
<th>Activities expected to be needed to achieve state (stage) transitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forming</strong></td>
<td>Group initially coming together. Communication is polite as true feelings are withheld. Ideas are simple. Acceptable things are said. Feedback is minimal. Members are getting to know each other and settling in. Strong dependence on team leader. Participation encouraged by all. Learning about other’s expertise, needs, values and preferences is facilitated. Members encouraged to ask questions in team meetings.</td>
<td>Team structure provided. Regular meeting schedules established. Roles, tasks and responsibilities clarified through discussion. Participation encouraged by all. Learning about other’s expertise, needs, values and preferences is facilitated. Members encouraged to ask questions in team meetings.</td>
</tr>
<tr>
<td><strong>Storming</strong></td>
<td>Marked by competition and conflict. Members try to find their role within the team. Members assert themselves, their views and opinions. Authority, leadership and positions challenged. Lack of collaboration and competition for control. Highest levels of participation. Little group identity. Team rules and norms have been challenged and questioned. Consensus taken and challenging problems have been discussed. Means of delegating have been established. Feedback requested and enabled. Open discussions about individual issues and concerns is enabled.</td>
<td>Formal role clarification process conducted. Norms, supporting expressions of different views, have been established. Members encouraged to state how they feel and to express views on issues. Members given needed resources to do their job.</td>
</tr>
<tr>
<td><strong>Norming</strong></td>
<td>Individuals start to settle into their team roles. Team members attitude shifts from one of competition to one of collaboration. Team identity starts to emerge. A greater degree of individual strengths and weaknesses. Team ground rules established. Systematic and synergistic methods of working are determined. Team rules and norms have been challenged and questioned. Consensus taken and challenging problems have been discussed. Means of delegating have been established. Feedback requested and enabled. Open discussions about individual issues and concerns is enabled.</td>
<td></td>
</tr>
<tr>
<td><strong>Performing</strong></td>
<td>High levels of creativity, openness and trust observed. Feelings of warmth towards other members. Easy acceptance of different views. High levels of achievement felt. Group takes time out to socialise. Use of team performance measurements established. Output quality high and team productivity high.</td>
<td>Assumptions, norms and traditional ways of behaving are questioned. Self-assessment mechanisms developed by the group. Each member’s contribution is celebrated. Members potential developed to its fullest, through task assignments, training, education and feedback.</td>
</tr>
</tbody>
</table>
6.3. Data collection methods

Data collection techniques adopted for the multiple-cases relied on data source triangulation. Triangulation in research refers to the combination of two or more theories, data sources, methods, or investigators in one study of a single phenomenon to converge on a single construct (Bratthall and Jorgensen 2002). In data source triangulation the investigator looks for sources with similar foci to obtain diverse views through a range of data about topic (Bratthall and Jorgensen 2002). The three sources of evidence used to look for similarities of data in different contexts were: documentation; physical artefacts and direct observations. These data collection techniques employed are summarized below.

6.3.1. Documentation. Documentary information is likely to be relevant to every case study topic. Documentary information generated from this study included:

- Intra-team memorandums and letters; all correspondence used within each team was conveyed using e-mail and copies of correspondence were stored within the case study database. These correspondences provided information concerning team meeting times and location; request for consultation; team meeting records circulation; and correspondence between the teams’ observer and the teams.
- Team meeting records that encompassed agendas and meeting minutes; though individual members carried out assignments between team meetings, much of the work of each team was done when all team members came together during meetings (Scholtes 1988).
- Team administrative documents such as team ground rules and operating policies; team administrative documents were used to identify and describe team ground rules, i.e. team norms and team operating procedures. These documents provided information regarding project description; project objectives; assessment criteria; meeting plans; team member descriptions; basic team rules and so on.

6.3.2. Direct observation. Direct observations ranged from formal to casual data collection activities. For these case studies observation protocol were developed as part of a broader case study protocol. Team behaviour, i.e. the degree of team working, during weekly team meetings was observed and recoded by the team observer (the first author of this paper). To improve the reliability of the observational evidence, a common procedure was adopted.

6.3.3. Physical artefacts. A final source of evidence used was physical artefacts, comprising: (1) the project teams’ interim reports and final reports, that included descriptions of enterprise models and results obtained from using those models; and (2) results from each team building activity, namely: team system development tests and Belbin’s (1981) team role profiles.

It should be noted that two independent observers marked each team’s report. The reports were marked with respect to their quality of content and presentation. The project supervisor (the second author of this paper) marked the report structure, while experts in the field of systems modelling graded the models generated and documented by the reports.

In summary, the data for the study was derived from:

- Team meeting records and team observer reports; which were used to determine properties of the task realization process, i.e. the extent to which the team executed its task and achieved project task goals from one semester week to the next.
- Team meeting records and team observer reports, which were used to determine task progression and teamworking progression from one semester week to the next.
- Team role self-perception scores of each participant.

Comparable, quantified measures of each teams’ performance were made. Team performance assessments were made largely on the basis of the quality of interim group reports and final group reports.

7. Development of a planning reference model for the case study teams

The authors sought to test the hypothesis that transitions between stages of teamworking development will naturally be linked to transitions between stages of task realisation with the newly formed case study teams executing an entirely new task. Here it was decided that this notion could be investigated by generating a common plan of task and teamworking progression for the four case study teams, where that plan is based on the assumption that there is such a link. Following which the actual task and team progression of the four teams could be observed and measured, by using the general reference models of task progression and teamworking progression described in Section 6.2 (and characterized by tables 5 and 6 respectively), so that actual case study
team progressions can be compared against the common plan generated and inferences drawn out.

The expected progression of the team system from one stage of task realization to another was derived from the teams’ project plan. This plan is shown in table 7, which documents the sub-tasks within the project and expected start and finish dates and predicted duration of each sub-task.

Table 7 is essentially a common task plan for all four case study teams. This task plan was generated as an interim step towards developing a common plan of task and teamworking progression for the four study teams. The interim step centred on developing task decompositions and task activities at a fairly high level of abstraction, bearing in mind the specific purpose of the four study teams described in Section 6.1, and their need to accomplish those tasks in a 10-week period. The common task plan documents the main sub-tasks that would be expected and fits these into the available timeframe bearing in mind the authors’ experience of being involved in other similar projects with industrial companies.

Having generated the common task plan shown in table 7, the next step taken was to use a simple synchronisation rule, that assumes a direct (one-to-one) ‘connection’ between task and teamworking progression, so as to develop the teamworking aspect of the common progression plan for the case study teams. The resultant case study reference plan is shown in tabulated form in table 8 and figure 4 that graphically predicted rates of teamworking development and task realization.

Based on this simplest of planning assumptions table 8 and figure 4 predict that all four case study team systems should reach maturity some time in week 7, i.e. they should exhibit behaviours of the performing stage of teamworking development and execute activities and events expected of the implementation stage of task realization, and then continue in this state until the end of the project.

<table>
<thead>
<tr>
<th>Table 7. Common task plan for the case study teams.</th>
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</thead>
<tbody>
<tr>
<td>No Sub-task description</td>
</tr>
<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td>Recognition</td>
</tr>
<tr>
<td>1 Identification of measurable objectives</td>
</tr>
<tr>
<td>2 Identification of project constraints</td>
</tr>
<tr>
<td>3 Determination of project goals</td>
</tr>
<tr>
<td>4 Decomposition of objectives into task activities</td>
</tr>
<tr>
<td>5 Development of an assessment or evaluation scheme</td>
</tr>
<tr>
<td>Understanding</td>
</tr>
<tr>
<td>6 Data collection</td>
</tr>
<tr>
<td>7 Types of products and their manufacturing processes</td>
</tr>
<tr>
<td>8 Generation Information for each product option which will include: Manufacturing enterprises and their operation Manufacturing process employed Main business processes Enterprise activities Advantages of each option Disadvantages of each option</td>
</tr>
<tr>
<td>Project assessment – interim report</td>
</tr>
<tr>
<td>Decision</td>
</tr>
<tr>
<td>9 Decide on the product type</td>
</tr>
<tr>
<td>10 Identify the manufacturing organization</td>
</tr>
<tr>
<td>11 ‘Identify the ‘as is’ ‘business processes’</td>
</tr>
<tr>
<td>Implementation</td>
</tr>
<tr>
<td>12 ‘Use CIMOSA templates to represent the ‘as is’ ‘business processes’</td>
</tr>
<tr>
<td>13 ‘Use causal loop diagrams to represent the ‘as is’ ‘business processes’</td>
</tr>
<tr>
<td>14 Identify possible changes or development of business processes</td>
</tr>
<tr>
<td>15 Determine possible ‘to be’ ‘business processes’</td>
</tr>
<tr>
<td>16 ‘Use CIMOSA templates to represent the ‘to be’ ‘business processes’</td>
</tr>
<tr>
<td>17 ‘Use causal loop diagrams to represent the ‘to be’ ‘business processes’</td>
</tr>
<tr>
<td>18 Identify the business process to be simulated</td>
</tr>
<tr>
<td>19 Simulate business process using Ithink model</td>
</tr>
<tr>
<td>Project assessment – final group report</td>
</tr>
</tbody>
</table>
However, it was understood that this synchronization assumption was very simplistic and that in reality transition barriers might well inhibit teamworking progression. For example it was understood that it would be difficult within a 10-week time span for the teams to achieve the high levels of trust needed to reach the performing stage of team development.

### 8. Experimental results and observations

Figures 5, 6, 7, and 8 respectively describe the state behaviours achieved by teams 1, 2, 3 and 4.

#### 8.1. Team 1 progression

From figure 5 it can be observed that for team 1, teamworking development and task realization progressed essentially synchronously during the early and latter stages of the project. Further, the development behaviours of team 1 (see figure 5) are fairly well correlated with the case study planning reference model of teamwork and task progression.

<table>
<thead>
<tr>
<th>Semester weeks</th>
<th>Team life cycle stage</th>
<th>Task life cycle stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forming 1</td>
<td>Recognition</td>
</tr>
<tr>
<td>2</td>
<td>Forming 1</td>
<td>Recognition</td>
</tr>
<tr>
<td>3</td>
<td>Storming 2</td>
<td>Understanding</td>
</tr>
<tr>
<td>4</td>
<td>Storming 2</td>
<td>Understanding</td>
</tr>
<tr>
<td>5</td>
<td>Storming 2</td>
<td>Understanding</td>
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<tr>
<td>6</td>
<td>Norming 3</td>
<td>Decision</td>
</tr>
<tr>
<td>7</td>
<td>Performing 4</td>
<td>Implementation</td>
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<tr>
<td>8</td>
<td>Performing 4</td>
<td>Implementation</td>
</tr>
<tr>
<td>9</td>
<td>Performing 4</td>
<td>Implementation</td>
</tr>
<tr>
<td>10</td>
<td>Performing 4</td>
<td>Implementation</td>
</tr>
</tbody>
</table>

Figure 4. Graphical representation of the case study planning reference model.

Figure 5. Actual development of team system 1.
Monitoring and predicting team system development

**Figure 6.** Actual development of team system 2.

**Figure 7.** Actual development of team system 3.

**Figure 8.** Actual development of team system 4.
model, described by figure 4. Indeed team 1 task realization states and state transitions proceeded much as predicted. Whereas the teamworking development aspect of team progression showed greater variation from the planning reference model, particularly over the weeks 5 to 8 period; first leading the task realization aspect then lagging behind it.

On close inspection of case study data collected about team 1, it was noted that greatest difference between team and task behaviours occurred in respect to the state 2 to state 3 transition. Indeed team 1 spent much of its time in the understanding stage of task realization, as it sought to define its task requirements.

8.2. Team 2 progression

From figure 6 it is evident that the teamworking development and task realization state behaviours of team 2 were not synchronous, although there was some correlation between the task realization aspect of team 2’s progress and that predicted by the case study planning reference model (described by figure 4). However team 2’s task realization progress regressed in week 9. Close inspection of team 2’s case data showed that this team probably spent insufficient time in the understanding stage of task realization and that this haste and consequent poor understanding of project goals caused the later regression. Little correlation was observed between the actual teamworking development progress made by team 2 and the predicted progression of the planning reference model. In fact team 2 lingered in the forming stage for the first four semester weeks, before reaching the storming stage. It remained in storming for a further four weeks before reaching the norming stage in week 3. After spending a week at the norming state team 2 regressed back to storming where it remained until the end of the project. Team 2’s teamworking development aspect never actually matured.

Apparent for team 2 some synchronization existed between teamworking development and task realization early in the project, i.e. up to week 3. But little evidence of synchronization was found beyond that point in time.

8.3. Team 3 progression

Figure 7 offers little evidence to support the proposition that teamworking development and task realization state behaviours was closely coupled in the case of team 3. Further, although some correlation was observed between actual (figure 7) and predicted (figure 4) state behaviours for team 3, the correlation was stronger in respect to task realization than it was for teamworking development. Team 3 lingered in the forming stage of teamworking development for five weeks and moved to the storming stage for the remainder of the project. Therefore it never really approached a mature state, and it was never observed as functioning as a holistic unit. Relative to the planning reference model it can also be deduced that team 3 spent less time than ideal on task understanding and too much time on task recognition.

None the less, figure 7 indicates that team 3 progressed through all stages of task realization during its 10-week lifetime. It spent four weeks recognizing project goals and requirements and a further 2 weeks understanding the customer requirements of the project. Subsequently task realization for team 3 progressed to the decision stage where it remained for one week. In week 8, team 3 progressed onto task implementation, i.e. stage 4 of task realization.

8.4. Team 4 progression

The case data on team 4 state behaviours closely mirrored that for team 3. Therefore similar conclusions can be drawn, namely: (1) that observations made about team 4 provide little evidence to support the proposition that teamworking development and task realization state changes are naturally closely coupled; and (2) that the planning reference model provided better predictions about task realization state behaviours than it did for teamworking development.

8.5. Discussion of results

It should be emphasized that the experimental observations and results reported have been linked to the most commonly quoted model of teamworking development posited by Tuckman and Jensen (1977). This model postulates that teamworking development is sequential, i.e. a team matures chronologically from forming to performing is a step-wise, uni-directional manner. However, Tuckman’s model does not inherently suggest that teamworking progression is always linear. For example a team may progress from storming to norming before resolving all of the issues from the previous stage. The occurrence of this kind of behaviour was evident within one of the case study teams, so that it may have been judged that a team had moved to a new stage, when in fact in reality it still needed to resolve certain issues associated with previous stages as well as issues associated with the current stage. Indeed in teams 2, 3 and 4 unsolved teamworking
development issues were seen to resurface later and in the case of team 2 may have caused the team to actually regress in its development to an earlier stage.

Observations made about the four case study teams did not lend support for the hypothesis being tested, i.e. that teamworking development and task realization state behaviours are essentially synchronous. Although the hypothesis was not validated within this research, two significant observations were made, namely:

(1) For each of the four case study teams, the common planning reference model could usefully predict task realization activities and could help interpret (and hence monitor) the extent to which each team had progressed relative to that plan.

(2) The planning reference model was not found to provide a useful tool to predict, plan and/or support the monitoring of teamworking development. With the benefit of hindsight, it is likely that this was because various factors can impact unpredictably on teamworking development.

The literature points to the existence of several factors that can limit or hinder teamworking development (Thamhain and Wilemon 1987, Katzenbach and Smith 1993, McDonald and Keys 1996). For example, Moxon (1993) proposes four categories of challenges that have been observed to impede teamworking development namely: (1) problems with goals; (2) problems with roles; (3) problems with processes; and (4) problems with relationships. Following on analysis of the progress made by the four student teams in this case, it was observed that four main parameters may have influenced the realization and the timing of transition from one stage of teamworking development to another, namely:

- Team development time: the time period taken for a team to become an efficient functioning unit. In practice it is expected that this time might be influenced by available project time (and possibly the project budget) and numerically this might tend towards the allowed project duration. In principle, the more time a team spends working together, the more the team will know about its goals and its member’s individual purpose. Improved understandings about members and team’s purpose and objectives can be expected to increase the cohesiveness of the group.
- Cross cultural communication: when team members are drawn from different cultures, they can be expected to vary in terms of their communication and interpersonal behaviours, including their motivation to seek and disclose information (proprietary to them) and in the need to engage in self categorization (Gudykunst 1997). One major dimension of cultural variability is individualism-collectivism (Hofstede 1980). In individualistic cultures, the needs, values and goals of the individual take precedence over the needs, values, and goals of the in-group. In collectivist cultures, the needs, values and goals of the in-group take precedence over the needs, values, and goals of the individual (Hofstede 1980, Gudykunst 1997). Previous research suggests that individuals from individualistic cultures that tend to be less concerned with self-categorizing, are less influenced by group membership, have greater skills in entering and leaving new groups, and engage in more open and precise communication; than would individuals from collectivist cultures (Hall 1976, Hofstede 1980, 1991). In addition, the willingness to respond to ambiguous messages, interpreted by Pearce (1974) to be a trusting behaviour, has been shown to be higher among members of individualistic cultures than among members of collectivist cultures (Gudykunst et al. 1996). Finally, previous cultural exposure is an important factor influencing communication behaviour (Wiseman et al. 1989). People with high confidence in the knowledge of other cultures tend to be more willing to explore cultural topics (Jarvenpaa et al. 1998). This might suggest that people who are more culturally experienced might seek and disclose proprietary information more than those who are not (Jarvenpaa et al. 1998).
- Team role balance: an important aspect of team role theory is that team roles should be balanced. Research conducted by Belbin (1981) suggests that when all eight of Belbin’s team roles exist at or above the natural role level (i.e. scores of 70 or above), teamwork and subsequently team performance can be significantly improved (McGregor 1960, Belbin 1981, Yates 1996, Prichard and Stanton 1999, Park 2002, Leung et al. 2003). Teams that are balanced with respect to their team role composition have previously been observed to be more consistently successful than for teams in which this balance is absent (Prichard and Stanton 1999).
- Team leader performance: existing literature reports that the role of the team leader is key particularly when a new team is performing a new task. The function of the leader includes: presiding over the team and co-ordinating its efforts to meet external goals and targets; identifying those...
members of the team that are strong or weak in each area of the team’s function; focusing people on what they do best; establishing the roles and work boundaries; and identifying gaps and taking steps to fill them (Belbin 1981). The leader’s role has been considered to be of particular importance in the first and second stages of teamworking development, when he/she clarifies goals and guides and directs the team towards goal attainment.

8.5.1. Discussion of teamworking development results with respect to the four parameters. Each of the four case study teams was assessed with respect to the four parameters described in the preceding section. Each team was awarded a value of ‘high’, ‘medium’ and ‘low’ in respect to the four parameters, as illustrated in table 9. These values were awarded based on information obtained from the teams during project execution, and were used to examine and discuss the teamworking progress of the test cases whose behaviours were depicted in figures 5–8.

The teamworking progress of team 1 was noticeably different from the other three test cases. Figure 5 indicates that team 1 progressed from ‘forming’ to ‘performing’ stage of team working development during the ten-week period. From table 9, it can be observed that team 1 achieved high scores for teamworking time, cross cultural communication, team role balance and leadership performance. Teams 2–4, on the other hand, were awarded low and medium

<table>
<thead>
<tr>
<th>Test cases</th>
<th>Teamworking time</th>
<th>Cross cultural communication</th>
<th>Team role balance</th>
<th>Leader performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team 1</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>This team of students had previously known each other and worked together on other projects.</td>
<td>The members of this team were from the same country and as such their attitudes and behaviours were comparatively similar.</td>
<td>This team exhibited all the positive indicators of a winning team identified by Belbin (1981).</td>
<td>This team leader demonstrated a high degree of competence.</td>
</tr>
<tr>
<td>Team 2</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>New team performing a new task.</td>
<td>Multi-cultural team with poor communication.</td>
<td>This team exhibited indicators of unsuccessful teams (Belbin 1981) such as poor morale; variations in culture generating different personalities; and poor team composition with respect to team roles.</td>
<td></td>
</tr>
<tr>
<td>Team 3</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>New team performing a new task.</td>
<td>Multicultural team with low levels of trust and poor communication.</td>
<td>Uneven balance of Belbin’s team roles.</td>
<td>One of the main responsibilities of any team leader is to resolve conflicts. He/she must remain impartial and to facilitate understanding among team members (Phillips 1997). In the case of Team 3 most of the conflicts and personality clashes occurred between the team leader and the team scribe.</td>
</tr>
<tr>
<td>Team 4</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>New team performing a new task.</td>
<td>Multicultural team with low levels of trust and poor communication.</td>
<td>Uneven balance of Belbin’s team roles.</td>
<td></td>
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</table>

Table 9. Case study team assessment with respect to four parameters.
scores for teamworking time, cross-cultural communication, team role balance and leadership performance. These three cases, unlike team 1, only progressed to the second stage of teamworking development.

Teams 2–4 received a low score for teamworking time. Unlike team 1, the students within each of these test cases had no prior knowledge about each other. Teams 2–4 were newly formed teams performing an entirely new task.

Teams 2–4 comprised students from diverse cultural backgrounds that included: Chinese, Thai, Swedish, Jordanian, Nigerian and Indonesian heritage. This diverse collection of cultures was observed to generate differences in group communication and behaviours.

Team 1 exhibited a balance of Belbin’s (1981) eight team roles. The other case study teams indicated an uneven balance of Belbin’s team roles. For example, Team 2 comprised three shapers and two company workers, which according to Belbin (1981) can result in intense conflicts within Stage 2 of a team’s development. Belbin (1981) further concludes that unless these conflicts are resolved, and ‘shapers’ learn to work together, the team will not progress through its developmental stages, but remain in stage 2. This was observed to be a phenomenon that limited team 2’s performance.

The leader’s performance in each of the case study teams was assessed during the entire project by the independent team observer and resulting values recorded into table 9.

9. Discussion

The preceding sections of this paper have developed tabulated models of team system development, i.e. in terms of descriptions of states and state transitions that characterize behaviours of teamworking development and task realization and govern their progression. The aim when developing these tables was to provide semiformalized descriptions (or models) of aspects of teams that industry might use to predict and monitor team progress, and thereby possibly to enable measurement of related aspects of team performance. A developed use of these semi-formal models enabled a common reference model of specific team progression to be developed for four case study teams, which could thereby provide planning and monitoring aids. This common planning and monitoring reference model was developed based on an assumption that teamworking development and task realization is naturally synchronous. Following this the reference model was used to interpret the actual progress made by four case study teams who independently were assigned a similar project. However in practice marked differences in teamworking development progression occurred amongst the four teams, but task realization progression was found to be similar in all four cases and occurred in much the manner predicted. Reasons for the marked differences in teamworking development progression were proposed with reference to established literature on teams.

Various observations were made in respect to the progress of the case study teams as outlined in Sections 8.1–8.4. In addition, the quality of the task outputs generated by each team were assessed by various means, focused primarily on the quality of the reports and the process and system models generated and documented by each team. An overall (albeit subjective) quality value was thus assigned to these outputs and to teamworking development achievements of each team. These values are summarized in table 10, as is an overall quality rating calculated by simply determining the average of the first two quality values assigned.

Although this represents a statistically small sample of teams, some indications can be drawn from the results obtained as outlined in the following.

- Indication 1: The quality of the task realization and teamworking development aspects of team 1 was significantly greater than that of the other teams. This is likely to have been because this team had reusable teamworking competences because of its pre-established composition that enabled it to progress significantly further, and significantly more rapidly, in terms of teamworking development than did the other teams. All teams delivered a task output deemed to be satisfactory but in a competitive situation, the ME designed by team 1 would have significantly outperformed those designed by the other teams. Indirectly this observation indicates that it is likely to be worthwhile to measure initial teamworking competences and subsequently to plan for, measure and promote teamworking progression, so as to develop more winning teams within industry, commerce and government. The semi-formal models described in this paper could provide basic tools to facilitate such a course of action.

- Indication 2: The hypothesis that teamworking development and task realization is likely to be

| Table 10. Quality values assigned to the case study teams. |
|-----------------|----------------|----------------|----------------|
|                 | Team 1 | Team 2 | Team 3 | Team 4 |
| Quality of outcomes | 80     | 55     | 60    | 60    |
| Quality of teamworking | 90     | 70     | 60    | 60    |
| Overall quality rating  | 85     | 62.5   | 60    | 60    |
synchronous was proved untrue and was clearly an over simplification in the general case. Therefore it is probably unlikely that measuring the progress of one of these developmental threads can usefully provide a surrogate measure of the other. The study cases showed how natural phenomenon could impede team system development, particularly in the case of teamworking development.

- Indication 3: It was observed that several factors can impact on teamworking development. This study identified four main parameters that may have influenced and in the case of teams 2–4 adversely impacted on their development. These factors included team development time, cross cultural communication, team role balance, and team leader performance.

10. Conclusion

A precept of this study is that teams are systems. As a consequence, team systems can be characterized by: (1) complex resources; (2) open system configurations; (3) constituent, inter-related sub-systems and components; and (4) functional requirements (Blanchard 1998). The aim of this paper was to discuss pre-existing teamworking development and task realization models with a view to developing understandings about the processes that occur during team system operation; and also developing notions about possible dependencies between teamworking development and task realization processes.

Initially a ‘framework’ was developed to monitor and predict two aspects of team system development. Here team systems were characterized in terms of task realization and teamworking development states and state transitions. Task realization processes determine ‘what the team actually does’ while teamworking development processes determine ‘how the what is achieved’.

Since the progress of team systems can be characterized with reference to either or both of these aspects, the authors hypothesized that there might be a natural coupling (or synchronization) between the two. In an effort to test this hypothesis, the behaviours of four case study teams were studied and the results reported herein. However, the case study findings did not provide real evidence to support the notion and showed that various parameters can enhance or impede teamworking development. Quantifying those factors and understanding how they interact may constitute potentially fruitful areas of future study.

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### QUERIES: to be answered by AUTHOR

**AUTHOR:** The following queries have arisen during the editing of your manuscript. Please answer the queries by marking the requisite corrections at the appropriate positions in the text.

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