

STANDARDISED PROCESS IMPROVEMENT FOR CONSTRUCTION ENTERPRISES: MANAGING CLIENT REQUIREMENTS

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Abstract

This paper introduces Standardised Process Improvement for Construction Enterprises (SPICE), a current research project that is developing a framework that can distinguish levels of increasing process maturity and offer a structured pathway towards continuous process improvement. The SPICE framework is based on the transfer of best practice from the IT industry and will refer specifically to The Capability Maturity Model (CMM), a step-wise improvement framework developed for the Department of Defence in America. Successful implementers have reported significant productivity improvements and defect reduction.

The SPICE framework is considered as a mechanism for controlling, measuring and improving briefing practice. The best construction practices have little value if the requirements of the client are not clearly understood and managed, both at project inception and as the brief evolves during the project life cycle. The traditional emphasis on design team responsibility for the project brief is challenged, the authors advocating the widening of requirements management to encompass the construction supply chain. A mechanism for using the SPICE framework to assess the requirements management capability of project participants is presented.

Keywords: Capability Maturity Model (CMM); Process Improvement; Standardised Process Improvement for Construction Enterprises (SPICE); Requirements Management.

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INTRODUCTION

The best construction practices have little value if the requirements of the client are not clearly understood and managed throughout the project life cycle. As early as 1964, the Banwell Report concluded that insufficient resources were devoted to defining project requirements (Ministry of Public Building and Works, 1964). Sir Michael Latham in his report 'Constructing the Team' (Latham, 1994) highlighted the diversity of construction industry clients, contrasting knowledgeable leaders in the construction process with those that rely on the expertise of construction professionals to guide them towards formulating their requirements. More recently, Sir John Egan in his report 'Rethinking Construction' has challenged the construction industry to a 10% reduction in construction costs and a 20% reduction in defects, emphasising the persistent customer dissatisfaction presently afflicting the UK construction industry. The report also highlights the improvement of processes as being paramount if the industry is to meet the client's needs. The importance of this report, from the collective opinions of the construction industry's most influential clients cannot go unheeded.

This paper will consider an approach for improving briefing practice based on the experiences of the IT industry. The SPICE project aims to develop a framework for the construction industry that can distinguish levels of increasing process capability (Sarshar et al, 1998). SPICE refers specifically to the Capability Maturity Model (CMM), which was developed for the Department of Defence in America (Paulk et al, 1995). This paper will examine the approach of the SPICE framework, specifically in relation to the management of client requirements, a key process area from the CMM, and consider its appropriateness in a construction context.

IMPROVING BRIEFING PRACTICE

The reports of Latham and Egan have provided fresh impetus for organisations to improve briefing practice. However, the capturing of client requirements has been the focus of considerable research over the past 30 years.

The client's brief is outlined in the RIBA 'Plan of Work' (RIBA, 1967), using a step by step approach from 'Inception' to 'Feedback' and clearly defining the manner in which the client's brief links into the construction process. The sequential nature of The Plan of Work was criticised due to its lack of flexibility and "sequential finality" (Tavistock, 1966), thus failing to respond to evolving requirements. Subsequent pioneering work in the 1960's by the Tavistock Institute addressed this issue by focusing on the improvement of communication during the briefing process. More recent work by Bejder (1991) also addresses the issue of communication, applying the Johari window concept (Luft, 1970) to the briefing process and concluding that increased mutual understanding and greater levels of trust are required for successful requirements capture.

Work by Gameson (1991) concluded that the approach used to capture requirements should vary depending on the experience of the client, an approach later supported in Sir Michael Latham's report 'Constructing the Team' (Latham, 1994). A model developed by Spekkink and Smits (1993) attempts to address the issue of client requirements evolving over time. Whilst still a staged approach to briefing, the model focuses on only making decisions when absolutely necessary. Thus, the brief become more detailed as the project progressed.

Bedjer (1991) highlighted the importance of receiving input from all parties whose needs are to be ultimately satisfied, citing a comparison of two building phases of the same project. Barrett (1991), also focuses on a more 'holistic view' of the briefing

process, with particular emphasis on the involvement of the facilities manager at the briefing stage.

Despite considerable research into the briefing practice, Sir Michael Latham's report on the UK construction industry (Latham, 1994) made similar conclusions to the Banwell report in respect of the need to improve the briefing process, despite three decades separating the two reports. Moreover, a recent survey of industry professionals confirmed that capturing client requirements remains a key determining factor in the overall quality of a construction project (Arditi and Gunaydin, 1998).

The recurring failure of the construction industry to successfully improve briefing practice is perhaps not surprising in the context of an atmosphere of mistrust, suspicion, fear of exploitation and dominated by short term financial considerations. Furthermore, the industry lacks a framework with which to prioritise process improvement efforts and direct resources efficiently. This paper will consider a process management approach towards improving requirements capture that is proposed by the SPICE maturity model.

THE SPICE MATURITY MODEL

SPICE is a current research project that is developing a process improvement framework for the construction industry. Evidence from other industry sectors suggests that continuous process improvement is based on smaller evolutionary steps rather than revolutionary measures typified by business process re-engineering strategies. SPICE is an evolutionary step-wise model utilising experience from other sectors such as manufacturing and IT. In particular, it is based on the principles of the Capability Maturity Model (CMM) developed at Carnegie Mellon University. Successful implementers have reported significant business benefits. For example, Hughes Aircraft (USA) reported a 5:1 return on investment, and Raytheon (USA) achieved a 7:7:1 return on investment and 2:1 productivity gains (Saiedian, 1995).

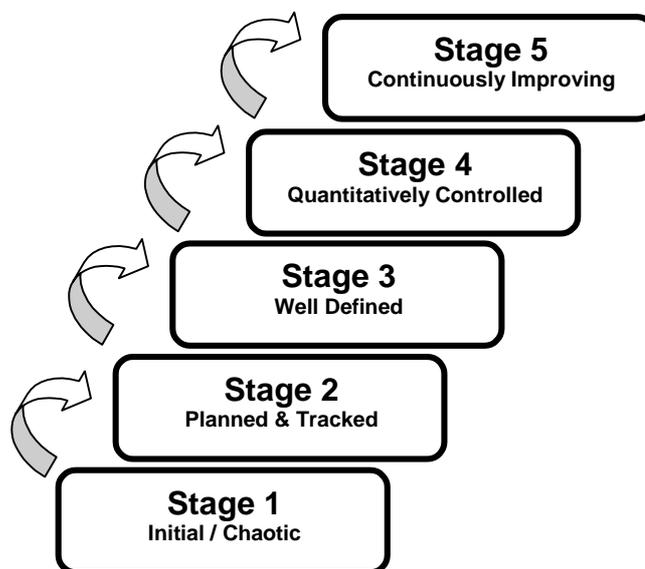


Figure 1 The draft SPICE maturity framework.

Presently the construction industry is without a standardised framework through which any improvements can be co-ordinated and repeated to provide synergistic gains. SPICE is being developed to offer direction to process improvement initiatives by

focusing on specific processes at each stage, eliminating bottlenecks which have so far hindered the construction industry in meeting its improvement targets.

The SPICE maturity model comprises of a five-stage maturity framework represented in Figure 1, and an assessment mechanism against which an organisation can be compared to the maturity framework. Currently the assessment includes a maturity questionnaire, a document review and structured interviews. The draft maturity framework is based on five evolutionary steps of process maturity, each step laying successive foundations for continuous improvement and defining a scale by which the maturity and capability of construction organisations can be measured. Each of the maturity stages comprises of a set of process management goals that when satisfied, stabilise an important component in the construction process. Only when all the key process areas at a particular stage have been satisfied, should an organisation focus on higher stages of the maturity framework.

The SPICE maturity model is being developed in collaboration with various industrial partners. AMEC Construction, a major UK contractor, and Cruickshank & Seward, a regional architectural practice, are working with a research team at the University of Salford to develop and test the framework and assessment mechanism on case studies. A panel of experts, including over 40 representatives from industry and academia is also being consulted to closely align the research with industrial requirements.

Process Management

Brief & Scope of Work Management is one of seven key processes addressed at stage 2 of the SPICE framework. At stage 2, all of the key processes relate to basic project management controls. As an organisation ascends the maturity levels, the focus of the framework shifts towards organisational process management, quantitative process understanding and continuous, measurable process improvement.

The SPICE framework is not prescriptive, and therefore does not constrain how an organisation manages project requirements. Instead, the 'Brief & Scope of Work Management' key process area comprises of process goals, five process management features that are deemed to be indicative of a mature process, and key practices that describe the activities and infrastructure that contribute to the effective implementation and institutionalisation of the process.

Management Features

Process management features are attributes that are indicative of whether that process is institutionalised and implemented in a manner which is "effective, repeatable and lasting" (Humphrey, 1995). These attributes are characteristic of a high level of process capability. The five process management features are shown in Figure 2. Each of the features can be thought of as a piece in a jigsaw. Whilst each feature adds value to the process capability, the combination of all the management features is greater than the sum of the constituent features. This point can be illustrated by considering the 'commitment' common feature in greater detail.

The management features comprise of key practices or attributes that are indicative of an effective, repeatable and lasting process. The development of a written organisational policy for managing client requirements is one of the key practices for the 'commitment' management feature and is a means of emphasising the connection between organisational commitment and the projects that actually perform the work (Paulk et al, 1995). The relationship between an organisation and remote projects is particularly significant in a construction context, due to the dynamic nature of construction project teams. This key practice also illustrates the emphasis placed on the

capability of the whole organisation, the objective being to provide clients with greater certainty when appointing the project team and not relying on individual 'heroes' within an organisation.

In order to carry out what the organisation has committed to, other factors need to

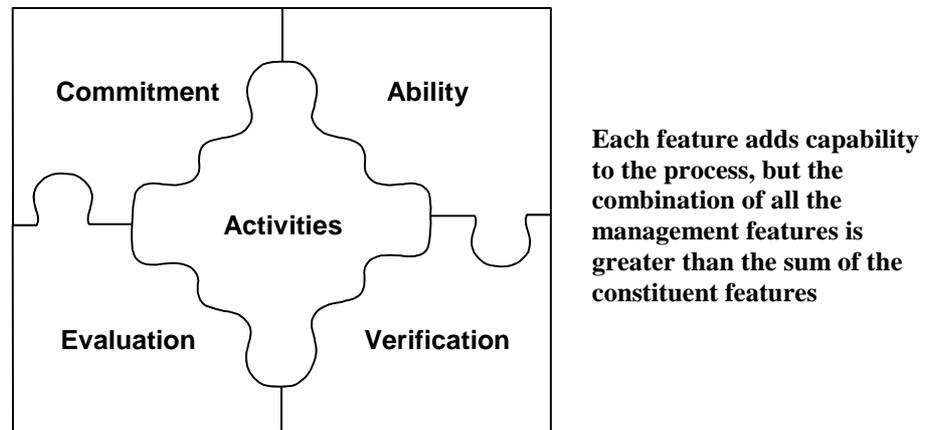


Figure 2 The process management features jigsaw

be considered. For example, the assignment of specific responsibilities, the provision of sufficient resources and trained staff, the review of activities for managing requirements and the conducting of quality assurance audits to verify that activities have been implemented in the manner specified. Failure to carry out these other key practices would undermine the commitment outlined in the written organisational policy, and therefore undermine the process capability. The collective importance of the management features is therefore apparent.

Each of the five process management features are described below: -

Commitment	The 'commitment' feature describes the actions an organisation must take to ensure that the process of managing requirements is established and will endure (Paulk et al, 1995). This is typically achieved through establishing organisational policies and senior management sponsorship.
Ability	The 'ability' feature focuses on the provision of resources for capturing and managing client requirements, in terms of funding, training and organisational structure.
Activities	The 'activities' feature includes the activities, roles and procedures necessary to capture requirements and to incorporate changes.
Evaluation	The 'evaluation' feature describes the basic evaluation practices that are necessary to determine the status of a process. These evaluations are used as a foundation for continuous 'process improvement'. "If you don't know where you are, a map won't help" (Humphrey, 1989, Preface).
Verification	The 'verification' feature describes the activities that ensure proposed practices are being implemented in a manner compliant with organisational goals.

An important aspect of the model is its flexibility. The diversity of the construction industry is well known. The benefits of an organisational policy may appear less appropriate within a small regional architect for example, than a large nation-wide contractor. Significantly, whilst the organisational policy is a key practice for this

process area, the format and specific contents are not dictated. The key practices can be tailored to specific organisational requirements.

Previous studies have compared briefing practice in the construction industry with that of other industries, such as car manufacturing and aircraft production, highlighting industry unique elements in the briefing process (Construct IT, 1997). Such studies may question the relevance of best practice transfer between industries. Rowlinson and Walker (1995) point out that the construction industry is characterised by its non-standardisation. Shamma-Toma (1998) goes further, recognising the dominant uncertainty and unpredictability associated with construction projects. However, the SPICE approach could be influential in addressing these issues, through the establishment of standardised procedures, helping to develop a more controlled, disciplined and mature approach to managing client requirements. Furthermore, the non-prescriptive nature and flexibility of the CMM, on which the SPICE framework is based, will help when translating best practice between industries, thus overcoming the potential barrier posed by the unique characteristics of the construction industry.

It is apparent that many of the issues addressed within the SPICE framework have been highlighted and addressed by previous research. The need for senior management to address process problems was emphasised by Deming (1982), most people generally doing their best within the constraints of the systems and procedures with which they are provided. Under-resourcing of the briefing process was highlighted as far back as the Banwell Report (1964), and reconfirmed in the report 'Constructing the Team' (Latham, 1994). The Tavistock Institute (1966) emphasised the need to consider the evolving brief, whilst Spekkink and Smits (1993) later developed a model to address this very issue. Although not revolutionary, the SPICE framework provides a vehicle for delivering many of the issues highlighted in previous research. Indeed, the lack of prescription within the framework permits it to be inclusive in relation to other research rather than exclusive. The framework directs organisations, and focuses attention towards priority issues. The manner in which those issues are addressed is not closely defined.

ADDRESSING THE SUPPLY CHAIN

The report 'Rethinking Construction' highlights the inefficiencies that construction suffers due to the separation of the planning, design, estimating and construction processes (Egan, 1998). 'Integrating to Innovate', a report prepared for the Construction Industry Council, also highlights the linkages between different construction participants including manufacturing and suppliers, and the effect these linkages have on innovative activities. The report defined supply chain integration as, "integration within and between construction supply chain firms, through aligning strategies, structures and processes" (Barrett & Sexton, 1998). The importance of the supply chain to the SPICE framework has been re-confirmed by the panel of experts that is directing the research.

Significantly the CMM, on which the SPICE framework is based, does not directly address the supply chain. Typically the supply chain is less influential in software projects. Despite this, Sommerville & Sawyer (1998) insightfully describe the application of viewpoints in relation to managing requirements with the CMM. The term viewpoint refers to the incorporation of different perspectives when capturing requirements. Barrett & Sexton highlight the advantages of this knowledge transfer in the construction industry, describing a knowledge soup flavoured by and supporting all of the constituent firms. "Findings have demonstrated that the effective transfer of knowledge from a specialist subcontractor to architects and contractors can considerably enhance buildability and, thus reduce building costs" (Barrett & Sexton, 1988, p10).

The potential for a client to benefit from the different project participant perspectives is clear. However, the information flow is bi-directional, each of the project participants extracting information from the project requirements to determine the work to be undertaken by them. The project requirements can comprise of many different types of documentation, tailored for specific participants, for example, drawings, specifications and scopes of work. All of this documentation is formulated from the initial client brief. The bi-directional flows from the project participants to the project requirements are represented in Figure 3. Each of the participants contributes to and extracts information from different portions of the project requirements documentation, which can be represented as influence circles. Where these influence circles overlap, there is potential for incompatibility, poor co-ordination between participants and poor traceability of changes. The project participants must manage project requirements effectively in order to address these risks. Requirements management cannot be considered as solely the responsibility of the design team.

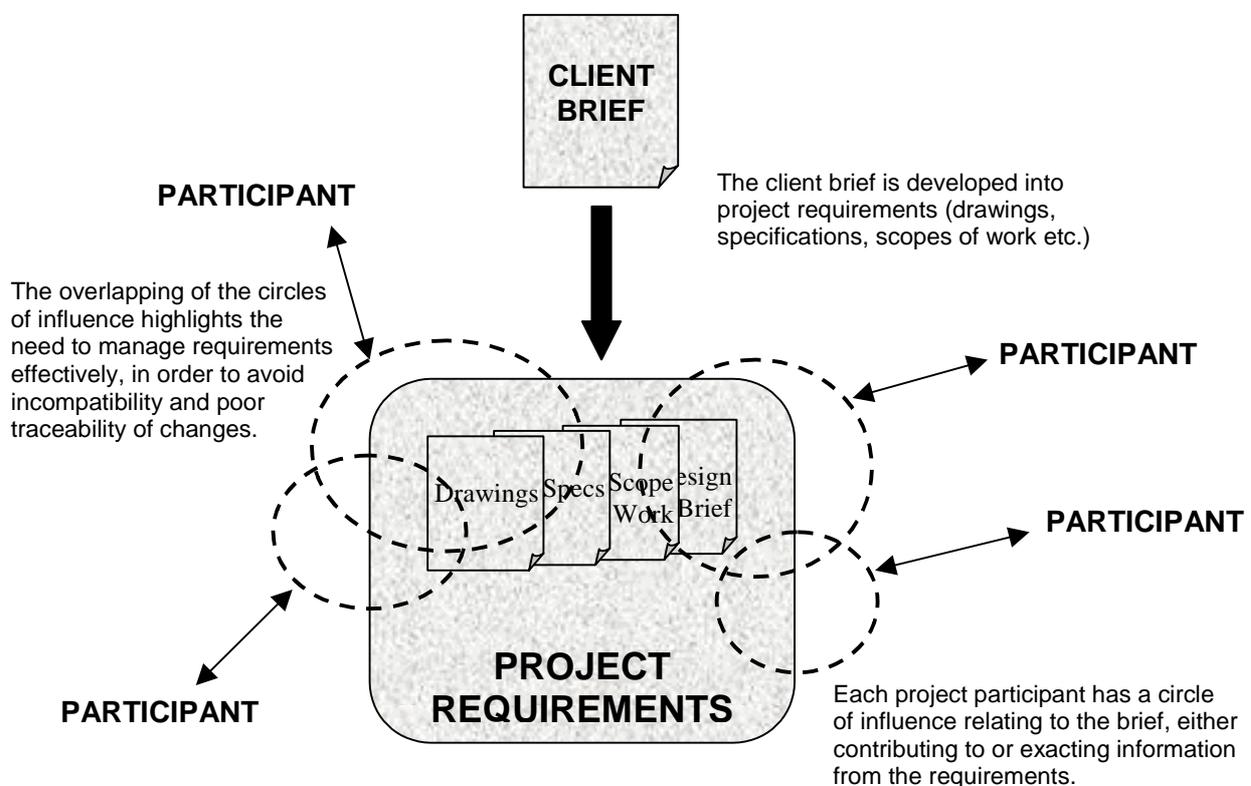


Figure 3 Bi-directional requirements information flow.

This scenario highlights a problem that the SPICE framework must address. The potential benefits of employing an organisation with a mature process capability in

'Brief and Scope of Work Management' may be diminished if the organisation is isolated in this capability within the project team. The CMM emphasises the need for, "a common understanding between the customer and project team" (Paulk et al, 1995). The project team emphasis is notable and particularly relevant in a construction context. Architects, contractors, subcontractors, suppliers, facilities managers and consultants are all common project participants that must be included within the umbrella term of 'project team'. The client requirements go beyond establishing a brief for the architect. Increasingly, suppliers and subcontractors are being utilised at the earliest stages of the project to draw on the expertise they can provide. The role of the supply chain in managing project requirements must not be ignored. Whilst clients may draw comfort from an architect's ability to manage project requirements and respond to changing requirements, that comfort will be misplaced if the rest of the supply chain fails to manage those requirements effectively. The final product will require overall project team capability, if the client's requirements are to be understood, managed and ultimately delivered.

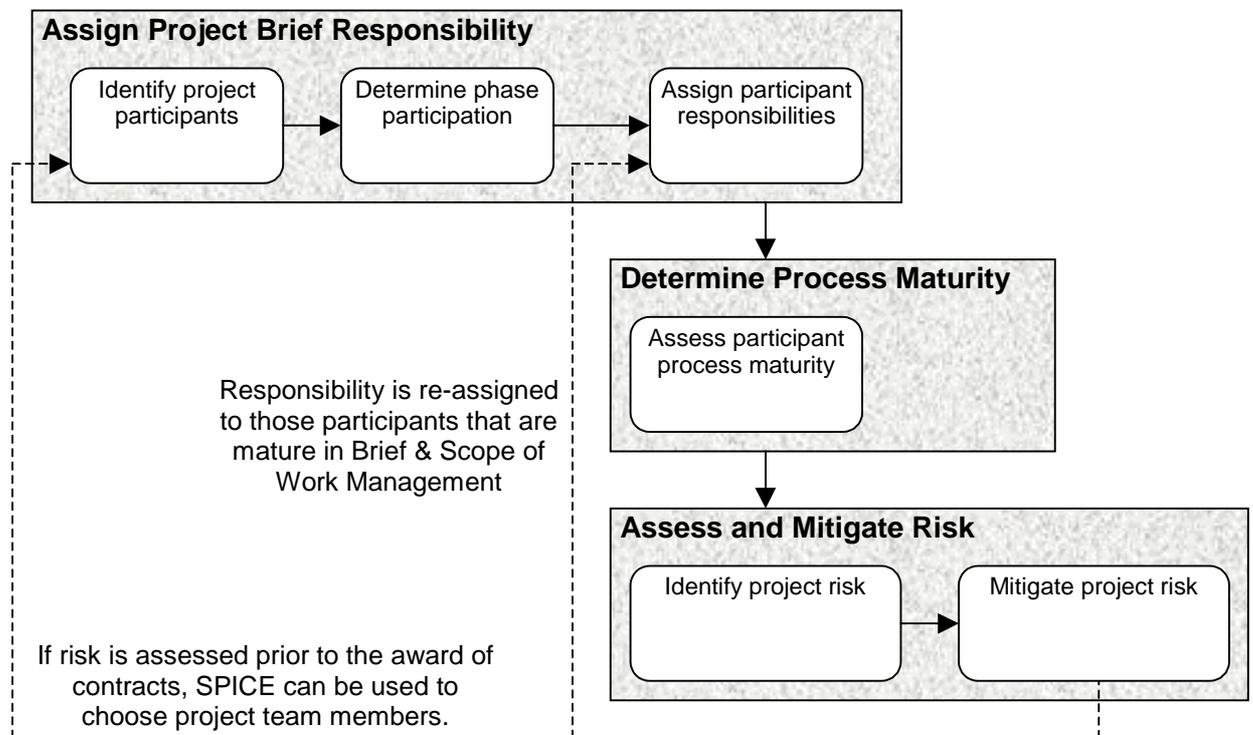


Figure 4 Project Capability Assessment.

Figure 4 represents a mechanism for applying the SPICE framework across the supply chain. The objective is to identify and mitigate risks that may be present due to the poor management of the project brief. This can be achieved through the identification of immature process capability within the project team. The Construction Process Protocol Map (Cooper et al, 1998), a generic construction life cycle model, can be used to divide a project into phases. Those project team members with responsibility for the brief at a specific stage of the project should have corresponding process capability in Brief & Scope of Work Management. To determine their process capability, each of the stakeholders can be assessed against the SPICE framework. The results from such an assessment would empower the client, giving them a greater understanding of the project team. If the assessment is used as a part of the

procurement process, then the client can attempt to assemble a team with good process capability for managing requirements. Alternatively, it can also be used as part of a risk management exercise. The client can then take steps to mitigate risks posed by members of the project team who lack the capability to manage project requirements effectively. Their responsibility for the brief could be transferred to other members of the project team for example. Whilst the cost and logistics of carrying out assessments may be prohibitive for single projects, the benefits over the course of a longer term partnering arrangement could offset those costs.

CONCLUSION

This paper has considered the SPICE maturity model as a mechanism for improving briefing practice within the construction industry. Many of the management features described within the SPICE framework have been highlighted in previous research. Whilst SPICE may offer few new ideas in respect of improving requirements capture, it is the authors contention that the framework being developed can provide organisations with a mechanism for prioritising process improvement issues and co-ordinating process focus initiatives, thus overcoming some of the apparent barriers to process improvement.

However, unless problems are addressed on an industry wide basis, a fundamental drawback to the implementation and improvement opportunities for the construction industry will remain. If the SPICE maturity model is to be effective, the significance of the supply chain must not be overlooked. Clients must be provided with a mechanism for assessing the requirements management capability of a whole project team, not just individual participants. A mechanism for meeting this requirement has been presented in this paper.

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