Barriers to Project Performance

Paul L. Bannerman
NICTA and University of New South Wales, Australia
paul.bannerman@nicta.com.au

Abstract

This paper contributes to our understanding of how the performance of IT projects might be improved. It identifies the need for including drivers of failure and underperformance in models of project performance and proposes such a model, focusing on organizational capabilities available to apply to projects. Barriers to learning and capability development are proposed that can offset capability accumulation, reducing the organization’s ability to perform well.

1. Introduction

Conducting successful information technology (IT) projects, consistently and repeatedly, is still a challenge for many organizations. As organizations become more and more dependent on IT infrastructure for their business operations, improving project delivery remains an important focus for research and practice.

There is evidence to suggest that we are getting better at projects. Practices such as reducing the size of projects, using agile methods, and improving project management skills through certification programs appear to be having positive effects. However, if industry statistics are to be believed, the problem is still significant. In their last survey, for example, the Standish Group found that only 37% of projects succeeded outright and 21% failed to complete [96]. However, 42% underperformed on one or more of completing within budget, to schedule and delivery of expected functionality. This suggests that IT projects are more likely to fail or underperform (63%) than succeed outright (37%). Based on these figures, a huge performance gap remains to be overcome.

This paper reviews the current dominant approaches to explaining and improving IT project performance (factor, process and capability approaches), and finds that they focus on performance enablers at the expense of considering negative drivers of project outcomes. With the aim of contributing to this research gap, the paper proposes a capability-based model of project performance that includes drivers of success and of failure. The contribution focuses on two types of performance barriers: one in which project-related learning is reduced or blocked due to various learning dysfunctions associated with established organizations (termed liabilities of incumbency), and; the other in which existing project-related capabilities are negated or made redundant due to newness and changed circumstances (termed liabilities of newness). The joint effect of these barrier conditions is to offset any learning and capability development that occurs, potentially diminishing the organization’s capability to successfully deliver projects.

The paper is a theoretical contribution of the form prescribed by Zmud [108]. The research method analyzes and synthesizes organizational learning, capability management and organizational ecology literature to provide new insights into the problem of project performance. Three contributions are made. First, the need for explicit drivers of underperformance and failure in project performance models is flagged. Second, disparate literature-based conditions that counteract learning are integrated into the two barrier categories. These are illustrated with practical examples of how they might affect IT projects. Third, an alternative capability-based model of project performance is proposed. Suggestions are also provided on how the proposed model might be tested.

The next section briefly reviews the prior research. Section three unfolds the proposed barrier conditions that can offset project learning and deplete the capability to execute projects successfully. It also integrates the contribution into an alternative model of project performance. The paper concludes with a discussion of the contributions and their implications.

2. Prior research

Prior research has predominantly focused on three main approaches to explaining project performance: project success, failure or risk factors; best practice processes; and project capabilities. Each is outlined.

Factor approaches. The most common explanation of project performance seeks to identify antecedent variables (factors) that affect project performance. Essentially, factor approaches argue that project performance is determined by taking account of recognized critical success factors, avoiding failure...
factors, and/or mitigating project risk factors ([8] [9] [10] [14] [17] [18] [26] [37] [80] [87] [106] [109]). Common critical success factors, for example, include: executive commitment; business/user involvement; clear objectives; stable requirements; minimized scope; project management expertise; change management; and suitable methodology and tools.

Fundamentally, this approach argues that if you do the right things in terms of managing identified performance factors, then the project will succeed. Furthermore, the more that things are done right, the greater the likelihood of success.

**Process approaches.** The next most common approach focuses on the intervening processes between inputs and outputs in project activities. Key processes in IT projects can include project management, the development method, risk management, configuration management, change management, and quality control. Essentially, process approaches argue that project performance is determined by following best practice processes, methodologies and techniques in each project situation ([4] [13] [16] [18] [23] [39] [69] [70] [75] [83] [84] [86] [89]).

Fundamentally, this approach argues that if you do things in the right ways by following prescribed project processes, the project will succeed. Furthermore, the closer the fit between processes and project requirements, the greater is the likelihood of success.

**Capability approaches.** More recently, capability-related approaches have begun investigating the problem from a variety of directions, including identifying personal capabilities that are important in achieving project success (e.g., [28] [30] [36] [51] [74] [90] [92]); identifying project team and organizational capabilities (e.g., [20] [29] [65] [85] [103]); examining the link between project management capabilities and project/organizational performance (e.g., [43] [45] [52] [56]); and investigating project capability building mechanisms and related structural forms (e.g., [7] [19] [31] [53] [78] [93] [94] [95]).

Fundamentally, this approach argues that you need the right skills and resources (capabilities) for a project to succeed. Furthermore, the better and more skilled the resources are, the greater the likelihood of success.

**Contribution assessment.** Each of these research approaches has pointed to key antecedent variables that have been found to impact project performance in practice. Managing these variables to improve their fit and application to IT/IS projects has been found to have performance improvement effects.

A limitation of these approaches, however, is that they focus on performance enablers at the expense of also considering barriers to project performance. They typically assume that project underperformance and failure result from inverse effects of the enablers. That is, projects underperform or fail because the key antecedent factor, process, or capability variables were not adequately managed. While this prior research shows that failure to take adequate account of predictor variables can indeed jeopardize project performance outcomes, mechanisms are typically not included in these approaches to explain performance fluctuations that occur in practice in the presence of ‘good’ project management [12]. They include no explicit drivers for underperformance or failure, just the assumption that if a project did not perform well, then one or more of the predictor variables must not have been managed well enough, so we should learn from the experience and “do better” next time.

By contrast, this paper argues for the recognition of explicit barriers to project performance that can account for project underperformance and failure in the presence of good factor, process, and individual skill management. Understanding and responding to these negative performance drivers is critical to closing the current research-practice gap in managing IT projects.

Given the industry evidence that IT projects are still more likely to underperform or fail than succeed outright [96], despite the contributions of current research approaches, this paper investigates barriers to learning and capability development as a way forward. This approach helps improve our understanding of why we have been slow to learn from over sixty years of project research and experience. The individual barriers are variously drawn from the literature but are integrated and applied here in a novel way as an additional explanation of performance. In contrast to the prior capability-related research discussed above, this research focuses on the organization as the level of analysis, and the capabilities it has to apply to projects (that is, on organizational learning and capability development to support projects), rather than the individual (competencies of project participants). The next section backgrounds the capability-based view of project performance, and describes the barrier conditions and their possible effects on IT projects.

3. Barriers to project performance

Capabilities are organizational resources that have potential to generate value for a firm [15]. They comprise an intricate mix of knowledge, skills, routines, technologies and values. A firm’s effectiveness in developing and deploying capabilities, including those needed to execute projects, determines
its performance outcomes. Indeed, the ability to build and leverage new capabilities is a capability in itself, called a ‘dynamic capability’ [49].

Organizational learning is the main generative mechanism of firm-specific capabilities. Capabilities are primarily developed through learning from experience or ‘learning by doing’ [60]. Organizational capabilities are developed and institutionalized in the operating routines, practices and values of the firm in a way that outlives the presence of specific individuals, and are adapted over time in response to further experiential learning [68]. Organizations can also deliberately build capabilities through management practices. Learning can be continuous (“single-loop learning”), resulting in improvements to existing capabilities, or discontinuous (“double-loop learning”), resulting in fundamentally new capabilities [1].

The literature also variously describes a range of barrier conditions that can reduce or block learning and capability accumulation or make existing capabilities obsolete in the face of new or changed circumstances. These regressive conditions can offset or negate the generative effects of learning on organizational capabilities, reducing or destroying the organization’s ability to perform well. These conditions are not coherently integrated in the literature. They are brought together here under two unifying concepts adapted from the literature (‘liabilities of incumbency’ and ‘liabilities of newness’).

3.1. Liabilities of Incumbency

Liabilities of incumbency are barrier conditions that slow or block learning and the incremental development and accumulation of capabilities. These conditions are often associated with the entrenched practices of established firms (hence they are a liability of holding an existing position in industry). Their effect is continuous, permitting various levels of flow like a water tap (plumbing faucet) whose valve is progressively closed to restrict or fully interrupt the flow. In the presence of such barrier conditions, organizations struggle to learn from experience and transform that learning into improved organizational capabilities. These barrier conditions are categorized according to three dysfunctions, discussed following: learning, capability, and organizational.

3.1.1. Learning dysfunctions. Many barrier conditions have the primary effect of reducing an organization’s learning rate or blocking its ability to learn. This limits the organization’s ability to develop and accumulate organizational capabilities needed to perform its operational and transformational activities. Examples of these conditions are described in Table 1.

As generic learning dysfunctions, these barrier conditions can affect learning and development of capabilities relevant to performing projects as much as to other business activities. For example, focus diversion can be a particular problem for IT projects. Team members can become preoccupied with the esoterica and challenges of implementing the technology at the expense of other implementation tasks such as the associated organizational changes needed to support and use the new technology. Also, with a short discrete lifetime, projects are particularly susceptible to learning myopia, limiting learning and capability development within and across projects over time. Transformative capacity is also an issue for preserving project learning. Critical in facilitating the transformative capacity of organizations for IT projects is processes and mechanisms such as post-implementation reviews, identification of lessons learned, project experience and knowledge repositories, and cross-project structures such as PMOs to retain and pass down project learning to future project teams. Failure to develop and put these mechanisms in place diminishes the organization’s capacity to extend project-related learning.

3.1.2. Capability dysfunctions. A number of barrier conditions can arise due to dysfunctions associated with existing organizational capabilities, which can inhibit or block new and further learning and capability development. Examples are described in Table 2.

These barrier conditions are also commonly found to affect IT projects. For example, the entrenched use of the ‘Waterfall’ development method in system development projects, even for highly dynamic and uncertain projects for which it is unsuited, is a classic case of how organizations can become stuck in a competency trap. Similarly, the continued use of a particular programming language or development platform for all new developments after better alternatives have reached mainstream adoption is an example of a core rigidity in development projects. Unjustified theories of use are also common in attitudes that dismiss holding a post-implementation review of a failed project (because “it’s not necessary, we know what went wrong”) or lead such reviews into a ‘blame game’, robbing the organization of a valuable learning opportunity. Tacitness can also be a performance barrier in IT projects. For example, the ability to write high volumes of code on a daily basis is substantially tacit. Some techniques may be easily codified, but the programmer is unlikely to be able to explain how he/she does it, limiting knowledge sharing and capability development. Finally, IT projects can also be affected by interconnectedness as a barrier. For example, a software developing organization’s ability
to develop software for a client within a particular industry can depend on the level and quality of its knowledge and relationships within that industry.

Table 1. Liabilities of incumbency resulting from learning dysfunctions

<table>
<thead>
<tr>
<th>Barrier Condition</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time compression diseconomies</td>
<td>It takes time for learning to build capabilities; this lead-time cannot be easily reduced; neither can shortcuts reduce the time it takes</td>
<td>Dierckx &amp; Cool 1989; Knott et al. 2003</td>
</tr>
<tr>
<td>Information processing limitations</td>
<td>An organization’s information processing capacity is bounded and can be overloaded, limiting and retarding new learning and development from information inputs</td>
<td>March &amp; Simon 1993; Tushman &amp; Nadler 1978; Lyytinen &amp; Robey 1999</td>
</tr>
<tr>
<td>Asset mass inefficiencies</td>
<td>Low initial levels of a capability make it difficult to learn, develop and further accumulate an existing capability</td>
<td>Dierckx &amp; Cool 1989</td>
</tr>
<tr>
<td>Absorptive capacity</td>
<td>An organization’s ability to learn and innovate is a function of the level of its prior related knowledge; low levels limit its ability to absorb new and further related knowledge</td>
<td>Cohen &amp; Levinthal 1990, 1994; Zahra &amp; George 2002</td>
</tr>
<tr>
<td>Transformative capacity</td>
<td>An organization’s ability to exploit and transfer knowledge across time impacts its learning and capability development</td>
<td>Garud &amp; Nayyar 1994</td>
</tr>
<tr>
<td>Learning myopia</td>
<td>Organizations sometimes simplify and specialize their learning by overlooking the long run, the larger picture, and failures</td>
<td>March 1991; Levinthal &amp; March 1993</td>
</tr>
<tr>
<td>Focus diversion</td>
<td>Preoccupation with new learning can reduce the maintenance of existing capabilities</td>
<td>March 1991</td>
</tr>
<tr>
<td>Need for unlearning</td>
<td>Past learning may need to be unlearnt to enable new learning and competence development to take place</td>
<td>Nystrom &amp; Starbuck 1984; Durand 2000</td>
</tr>
</tbody>
</table>

Table 2. Liabilities of incumbency resulting from capability dysfunctions

<table>
<thead>
<tr>
<th>Barrier Condition</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competency traps</td>
<td>Exploitation of existing capabilities developed from past successes is favored, inhibiting new learning and capability development</td>
<td>Levitt &amp; March 1988; Levinthal &amp; March 1993</td>
</tr>
<tr>
<td>Core rigidities</td>
<td>Core capabilities retained and applied inappropriately become core rigidities and inhibit new learning</td>
<td>Leonard-Barton 1992, 1995</td>
</tr>
<tr>
<td>Unjustified theories of use</td>
<td>Inappropriate and defensive routines prevent or greatly reduce learning when it is most needed (such as when failure occurs)</td>
<td>Argyris (1977, 1991; Lyytinen &amp; Robey 1999</td>
</tr>
<tr>
<td>Causal ambiguity</td>
<td>Lack of detailed understanding of the makeup of capabilities can make it difficult to develop and maintain them (but this can also be a great benefit in preventing imitation by competitors)</td>
<td>Lippman &amp; Rumelt 1982; Dierickx &amp; Cool 1989; Reed &amp; DeFillippi 1990</td>
</tr>
<tr>
<td>Tacitness</td>
<td>Difficulty in articulating what we know and do limits knowledge sharing / transfer and, therefore, learning from others (but this can also be a great benefit in preventing imitation by competitors)</td>
<td>Polanyi 1966; Attewell 1992; Nonaka &amp; Takeuchi 1995</td>
</tr>
<tr>
<td>Complexity and embeddeness</td>
<td>Effective capabilities are socially complex and deeply embedded in the organization, which also makes it difficult to maintain and exploit them</td>
<td>Kogut &amp; Zander 1992; Hansen 1999; Garud 1997; Brown &amp; Duguid 1998</td>
</tr>
<tr>
<td>Stickiness</td>
<td>Firm-specific capabilities are so deeply embedded in situational contexts that they cannot easily be fully explicated or transferred</td>
<td>von Hippel 1994; Szulanski 1995, 2003</td>
</tr>
<tr>
<td>Interconnectedness</td>
<td>Developing a capability may be constrained by its complementarity with other organizational capabilities</td>
<td>Dierickx &amp; Cool 1989</td>
</tr>
</tbody>
</table>

3.1.3. Organizational dysfunctions. Other barrier conditions arise due to dysfunctional characteristics of the organization, which can inhibit or block new and further learning and capability development. Examples of these conditions are described in Table 3.

Some of these barrier conditions directly relate to IT projects (such as certain project characteristics and system rigidities). The relevance of others may be less obvious. Take low aspiration levels, for example. Projects are susceptible to truncated learning because learning and capability development are not objectives of most projects. Any learning that occurs is usually peripheral. Also, the structural design of projects can affect project performance. Projects are often isolated from the parent and/or client organization, creating barriers to capability exploitation and development. Finally, HR development policies and practices can directly impact project performance. Project roles, such as project manager, often have shallow career paths in organizations. Investing in the development of project resources is a fundamental pre-requisite for being able to conduct successful projects.
Table 3. Liabilities of incumbency resulting from organizational dysfunctions

<table>
<thead>
<tr>
<th>Barrier Condition</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational inertia</td>
<td>Deeply established practices (especially successful ones) resist change (especially in stable environments), stifling the use and development of other capabilities</td>
<td>Ayas 1996, 1999; Nadler &amp; Tushman 1997; Lyytinen &amp; Robey 1999; Schulz 2001; Mohrman et al. 2002</td>
</tr>
<tr>
<td>Low aspiration levels</td>
<td>Low aspiration levels (satisficing) shut off learning too early, resulting in partial learning and under-developed capabilities</td>
<td>Winter 2000</td>
</tr>
<tr>
<td>Managerial cognition</td>
<td>An absence of strong managerial beliefs inhibits new learning search processes and the development of new capabilities</td>
<td>Tripsas &amp; Gavetti 2000</td>
</tr>
<tr>
<td>Certain organizational designs</td>
<td>Organization structures, processes and practices can create artificial boundaries that limit learning, knowledge sharing and capability development, especially with respect to IT Projects</td>
<td>Ayas 1996, 1999; Nadler &amp; Tushman 1997; Lyytinen &amp; Robey 1999; Schulz 2001; Mohrman et al. 2002; Bannerman 2010</td>
</tr>
<tr>
<td>Certain project characteristics</td>
<td>The duration of projects is usually too short for effective capability development; projects provide a poor framework for making capability development an objective; projects are usually resourced by diverse temporary personnel, including contractors, making it difficult to build capabilities that can be utilized again</td>
<td>Leonard-Barton 1992; DeFillippi &amp; Arthur 1998; Pettigrew 1998; Lampel 2001</td>
</tr>
<tr>
<td>System rigidities</td>
<td>Over-reliance on inflexible information systems and restrictive use of tools inhibits organizational learning and development</td>
<td>Orlikowski 1993; Gill 1995; Robey et al. 2000</td>
</tr>
<tr>
<td>Human resource development</td>
<td>Lack of appropriate technical and business training and education, and incentives to learn, limit learning and capability development</td>
<td>Lyytinen &amp; Robey 1999</td>
</tr>
</tbody>
</table>

3.2. Liabilities of Newness

Liabilities of newness are barrier conditions that, in the face of newness and/or changed circumstances, make existing capabilities redundant or obsolete, reverting the capability status of the organization to that of a new start-up, creating a high propensity to underperform or fail ([97] [47]). Their effect is discontinuous, requiring different capabilities to those needed previously. Technology is a powerful source of discontinuous change, especially in major IT projects. These discontinuities can make capabilities redundant very quickly, turning back the ‘liability of newness clock’ of an organization towards zero, increasing its vulnerability to underperform or fail.

Examples of liability of newness barrier conditions are summarized in Table 4.

By definition, a project is a microcosm of newness ("a project is a temporary endeavor undertaken to create a unique product, service, or result” – PMI’s PMBoK). IT projects, in particular, typically operate at the frontier of technological and organizational change and newness. This makes them especially susceptible to liability of newness threats. Recognizing and understanding the potential effects of these conditions is essential for acquiring and preserving the capabilities that are needed to perform well in new, uncertain and constantly changing environments.

Figure 1 integrates these learning and liability effects in a matrix of capability drivers.

3.3. Model of project performance

Putting these elements together, Figure 2 presents a capability-based model of project performance. The model includes the generative mechanism that is already recognized in the literature (organizational learning) and also adds drivers of underperformance (liabilities of incumbency and newness), which are not explicitly recognized in the currently dominant explanations of project performance. According to the model, project performance is the contested outcome of these joint effects, which are difficult to predict, resulting in persistent variations in project outcomes. More formally, project performance is the contested outcome of the positive effects of learning and the negative effects of liabilities of incumbency and newness on organizational capabilities available to the project.
Table 4. Liabilities of newness

<table>
<thead>
<tr>
<th>Barrier Condition</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newness</td>
<td>Young and established organizations facing significant change (or changed circumstances) may have insufficient capability stocks to survive or succeed</td>
<td>Stinchcombe 1965; Hannan &amp; Freeman 1984</td>
</tr>
<tr>
<td>Technological discontinuities</td>
<td>Major technological shifts can enhance or make existing capabilities redundant (depending on their position), potentially leading to project underperformance or failure</td>
<td>&amp; Anderson 1986; Christensen 2000</td>
</tr>
<tr>
<td>Architectural innovations</td>
<td>Reconfiguration of an established system to link together existing components in a new way destroys the usefulness of embedded architectural knowledge</td>
<td>Henderson &amp; Clark 1990</td>
</tr>
<tr>
<td>Technological change</td>
<td>Technologies are developing faster than the capabilities to effectively use them</td>
<td>Leonard-Barton 1992</td>
</tr>
<tr>
<td>Radical methods</td>
<td>Management methods such as radical business process reengineering destroy the value of existing capabilities vested in the status quo, leading to a high propensity for such projects to fail or not fully realize the intended benefits</td>
<td>Hammer 1990; Galliers 1997</td>
</tr>
<tr>
<td>Asset erosion and organizational forgetting</td>
<td>Capability stocks may be subject to ‘ossification’, decay and/or may become redundant over time; organizational ‘memory’ vested capabilities decays, resulting in unintentional loss of valuable embedded capabilities and knowledge</td>
<td>De Holan et al. 2004; Dierickx &amp; Cool 1989; Knott et al. 2003</td>
</tr>
<tr>
<td>Staff loss through turnover, downsizing and outsourcing</td>
<td>High staff turnover, downsizing and outsourcing/offshoring drain accumulated experience (capabilities) from organizations</td>
<td>Simon 1991; Lyytinen &amp; Robey 1999; Fisher &amp; White 2000; Quinn &amp; Hilmer 1994</td>
</tr>
</tbody>
</table>

Figure 2. Project Performance Model

In IS/IT projects, especially large transformational ones, the initial capability stocks plus the learning that occurs on the project can be less than the liability effects experienced during the project. Even with good project management in place, this can result in a net competence liability that leads to underperformance. This trade-off can explain why an organization might have an outstanding success with one project and a total failure with the next, or vice-versa. Other existing project performance approaches struggle to explain this variation in outcomes.

4. Discussion and conclusion

This research has identified the need for an explicit driver of underperformance in project performance models and proposed a capability-based model that includes barrier conditions that can explain variations in performance outcomes and why IT projects might be more likely to fail than succeed.

The research has limitations. First, the contribution is theoretical and requires validation. Independently, the model has been initially verified in a longitudinal case study [12] and several shorter case studies. Case studies are a useful method to examine the dynamics proposed in the model. Event studies and surveys could also be used. Second, the current model defines the barriers generically as learning and capability building dysfunctions that directly affect capabilities. The model does not represent finer-grained interactions. Further work is needed on, for example, intervening effects (such as moderation) and the role of complementarities. Third, implementation strategies are needed to provide guidance in applying the model in practice. These are topics for future research.

The paper has implications for research and practice. First, for research, new insights into long standing problems may benefit from re-examination of underlying assumptions and alternative explanations that take a different functional form. Second, the model provides a theoretical justification for IT sourcing beyond the ‘buy versus build’ decision and resource dependency theory. Improving capability use and access has long been recognized as a key motivator in sourcing services externally but an explicit justification model has been lacking. The proposed model implies that firms are better-off building capabilities that are
fundamental to their primary business and sourcing other required capabilities externally from firms that are similarly able to specialize in those capabilities. This improves the chances of each party staying in the continuous learning part of the model, limiting exposure to liability conditions. Finally, the model challenges the existing strategy of implementing IT-enabled change through a program of coordinated projects. The proposed model suggests that transformational projects are quasi-independent events that are fundamentally discontinuous. Relying on a pattern of cumulative, consistent outcomes could be hazardous (and often is, in practice). This suggests that more research is needed on managing IT-enabled change strategies via projects from an organizational capability perspective.

For practice, organizations need to become better at ‘riding the learning curve’. A key challenge of the proposed model is to position the organization in the learning part of the model to limit exposure to liability conditions. This means building and nurturing capabilities that make sense for the organization and fit its operating model, business objectives and strategies. This may mean, for example, that it is better to develop capabilities in managing outsourced service delivery – such as for the development of new systems – than to try to build complex, changeable technical capabilities in systems development in-house. Outsourcing would enable the organization to further develop its own internal service delivery capabilities in managing the delivery from the service provider, positioning it in the continuous learning part of the model. Similarly, the service provider is able to leverage the cost of building capabilities in the work of the project across multiple clients and concurrent projects, because this is its core business, thereby also biasing its position towards the learning part of the model. These strategies also need to be supported by a heightened awareness of the capability implications of projects that are undertaken and potential discontinuities that might impact them.

Exploring organizational capability in performing projects makes sense, because capabilities are about the ability to do things well (and, ideally, doing them better than competitors). As an alternative direction of investigation, this paper contributes to bridging the current research-practice gap in understanding and managing the problems of project performance.

5. Acknowledgments

NICTA is funded by the Australian Government via the Department of Broadband, Communications & Digital Economy and the Australian Research Council through the ICT Centre of Excellence program.

6. References


