

TEAM WORKING IN ROAD MAINTENANCE FUNCTIONS FOR SUSTAINABLE CONSTRUCTION IN SRI LANKA

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ABSTRACT

Road maintenance is a continuous process that ensures a proper road network with safe and comfortable riding facilities are available to the road users. Among the few research studies on road maintenance, most of them suggest better contractual arrangements to improve road maintenance performance. This paper takes a different stance by looking into the team working aspects of road maintenance teams and suggesting avenues to improve team performance for sustainable road maintenance in general. Literature lacks in discussing how teams perform in road maintenance activities. Hence, the aim of this research was to explore how team working takes place in road maintenance functions and how to improve team-working towards sustainable road maintenance in Sri Lanka. The case study research approach was selected for this study. Accordingly, three case studies with three Executive Engineer's Divisions within the Road Development Authority were undertaken. The findings revealed how maintenance personnel worked as teams during different phases of road maintenance. However, several areas needed improvement as suggested in the paper. These findings will be useful for performance improvements of road maintenance activities in general.

Keywords: Case Studies; Road Maintenance; Team Performance; Team Working.

1. INTRODUCTION

Researchers all over the world have highlighted the significance of teams in organisational perspective (Fisher *et al.*, 1997; Mendelsohn, 1998). Many of them explored the nature and function of team working (Peter and Bamberger, 2009), learning capability (Hubber, 1999; Murry; Moses, 2005) and many other qualities of teams. Working as a team in an organisation results in increased productivity (Moses and Stahelski, 1999). Bacon and Blyton (2003) indicated that teamwork has a greater positive impact upon both organisational performance and human resource outcomes.

The concept of "teamwork" is very much appropriate for the construction industry as the construction of a product is a collective effort of professionals (Senaratne and Hapuarachchi, 2009). According to Cornick and Mather (1999, p.5), "construction itself probably generated the earliest examples of team work." Various authors have highlighted the importance of teamwork in construction projects". For example, Danston and Reed (2000) have reported that the improved teamwork among design team reduced design costs. In addition, team building approaches in projects reduce the total project cost (Albense, 1994). Also, Chan *et al.* (2001) have shown that improved team performance in construction projects increased participants' job satisfaction.

The importance of teamwork in construction is not just limited to the design and construction stages. It is equally important in the maintenance stages. Albert (1998) emphasised that if the top-level objectives of the maintenance strategy are to be accomplished, they ought to be cascaded into team and individual goals. However, as Albert (1998) showed, the effectiveness of the maintenance function has become a major management issue.

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In particular, the effectiveness of the road maintenance function has become a major management issue (Richard *et al.*, 2000) as road maintenance is an essential activity (Oliver, 2002; Klockow and Hofer, 1991). For example, well-maintained roads support national and local economies by ensuring that freight and businesses can move efficiently and safely (Guptha, 2008). Further, the way of life now depends substantially on the availability of the road networking. Also, various acts of Parliament place legal obligations on road authorities to maintain their roads in a safe condition, and to ensure that maintenance operations are carried out safely.

Typically, the road maintenance function is perceived to be confined to the tactical role of maintaining, servicing and fixing facilities already in place. With such a perception, road maintenance is often regarded as an expense account and a popular target for cost reduction programmes. Although the budgets for these maintenance activities are planned prudently, based on the engineer's estimate, changes usually occur in the work plans after the maintenance work starts (Shrestha *et al.*, 2014). Albert (1998) revealed that maintenance is not only a tactical matter, but also it has a strategic dimension covering issues such as design of facilities and their maintenance programmes, upgrading the knowledge and skills of the workforce, and deployment of tools and manpower to perform maintenance work. It was noted that recent research on road maintenance focuses on suggesting alternative contractual arrangements (for example see, Lam and Gale, 2014; Costello *et al.*, 2014; Shrestha and Shrestha, 2014) rather than the internal team performance. A maintenance team generally performs this maintenance task. However, less evidence found in literature emphasising teamwork issues of such maintenance teams, particularly, in road maintenance teams. Identifying this research gap, the key research question that this study addresses is "How team working takes place in road maintenance functions?" The literature findings related to this question are discussed next.

2. KEY FINDINGS FROM THE LITERATURE

2.1 THE CONCEPT OF MAINTENANCE

Various authors have explored their ideas regarding the concept of maintenance in management literature. Among those authors, Liyanage and Kumar (2003) have explained the evolution of maintenance concept. Accordingly, prior to the early 1900s, maintenance was considered as a necessary evil. When technology was not in a state of advanced development, there was no alternative for avoiding failure, and the general attitude to maintenance was, "it costs what it costs." With the advent of technological changes and after the Second World War, maintenance became as an important support function for production and manufacturing. During 1950-1980, with the advent of techniques such as preventive maintenance and condition monitoring, the maintenance cost perception changed to: "it can be planned and controlled." Today maintenance is considered as an integral part of the business process and it is perceived as: "it creates additional value" (Liyanage and Kumar, 2003). However, maintenance is normally perceived to have a poorer rate of return than any other major budget item.

Many authors have defined maintenance in management literature. According to European Standard EN 13306, maintenance is defined as the combination of all technical and administrative actions, including supervisory actions, intended to retain an item in, or restore it to, a state where it can perform a required function. In this sense, a combination of generic maintenance activities or actions that are repeated and transforms input into output may be seen as a maintenance process (Campbell and Jardine, 2001). Hence, the repetitiveness is an important characteristic of the maintenance process, since it distinguishes the process from a project or a linear description of cause and effect without any feedback (Soderholm *et al.*, 2007).

The maintenance process can be related to the four phases of the common Deming's Improvement Cycle (Plan-Do-Study-Act) as follows: Maintenance Planning (Plan), Maintenance Execution (Do), Functional Testing (Study), and Feedback (Act). In the Maintenance Planning phase, several inputs such as information about the health of the current system and maintenance documentation are needed to prepare the maintenance plan. In the Maintenance Execution phase, main input is the maintenance plan while maintenance environment, maintenance documentation, and the actual availability of time, personnel, and resources are all needed for successful execution. The purpose of Functional Testing is to test the function

of an item, in relation to some requirements. Functional Testing may be performed continuously, or periodically during scheduled checks, in order to establish the current health of the system and the actual need for maintenance. The Feedback after execution phase should pass mainly from Functional Testing to Maintenance Planning and Maintenance Execution phases. In all these phases, a team of personnel perform the required maintenance tasks and the next section explores the concept of team in maintenance.

2.2. TEAM WORKING IN MAINTENANCE

Various researches have defined the term “team” in various ways. Amongst these definitions, the following given by Katzanbach and Smith (1993) is the one commonly cited: “a team is a small number of people with complementary skills, who are committed to a common purpose, performance goals and approach for which they hold themselves mutually accountable”. Teams and teamwork is an area long being studied in different context and fields. However, there are very few attempts on studying teams in maintenance context.

Hambleton (cited Knapp and Mahajan 1998) developed a manpower-planning model for maintenance personnel considering different maintenance areas for forecasting the maintenance team, such as areas (technical and/or geographical), craft-type (fitter, welder, etc.), training levels (experience), and sub-contracted and in-house employees. This can be taken as one way of categorising different teams in maintenance.

In addition, maintenance teams can be described as permanent teams. Panteli and Dibben (2000) explained about permanent teams in maintenance against the most common temporary teams. The notion of a permanent team describes the situation where there is continuity in the membership of the group; that is, where a particular group of people regularly addresses ongoing issues such as maintenance (Townsend *et al.*, 1998). This is different to a temporary team, which is characterised by discontinuity, exists only to accomplish a specific task, and then disassembles. On the other hand, maintenance teams can be regarded as self-managed teams, as they have day-to-day responsibilities and take action on their problems (Appelbaum, 1999). When the skills, talents and energy of individuals are combined and weaknesses mitigated, then the team members find the key to maximum productivity. However, there is a dearth of literature, which explores team working in maintenance.

As per general management literature, several key features were identified that applies to maintenance teams. In management literature, Crocker (1999) has explored about the human nature in maintenance, “Humans, alas, are fallible. They have emotions, get tired, lose concentration and become distracted.” Hence, leadership is not an exception in maintenance activities. Similarly, communication plays a key role in team working of any teams. In addition, Knapp and Mahajan (1998) highlighted the need to have the right number of workers with the right capabilities in the right maintenance areas in maintenance jobs. Thus, team composition and their capabilities are two key aspects that relate to better team performance. Further, the importance of trust in holistic and middle management is emphasised and is seen as very relevant to maintenance teams. According to Hartenian (2003), team training and experiences positively correlate with team knowledge, skills and abilities in maintenance team. In fact, as Bamber *et al.* (2002) argue, modern maintenance engineers are expected to contribute to the continuous improvement of operations in working teams.

In summary, even though the importance of project teams are discussed by various authors in the past, the function of teams involved in road maintenance and the performance of road maintenance teams have not appreciated sufficiently in the management literature. It is important to understand how they work as teams in real-life scenarios. Identifying this research gap, road maintenance teams operating in Sri Lanka was chosen for this research as described next.

3. RESEARCH METHODOLOGY

According to Easterby-Smith *et al.* (2002), ‘Interpretivism’ is one key research philosophy, which believes that the reality is subjective and interior to the people. When considering the research question of this research, it is obvious that this study needs a vigilant observation of human interactions and behaviours. This particular issue forces the researcher to assume that the reality, which the research

problem seeks, is within the people. Hence, interpretivism research philosophy was adapted in this research.

A suitable research approach had to be selected to deal with the research problem, after defining the research philosophy. The research problem in this study is “how the teams perform in road maintenance functions in Sri Lanka.” According to Yin (2003), the case studies are appropriate when the research problem is “how” and “why” type of questions. Yin (2003), further stressed that the case studies can be very useful when little is known about a particular phenomenon. In this research, too, the knowledge on the research area is very little or almost nil, due to scarcity in maintenance related teamwork research. Hence, case study approach was selected for this research study.

The cases (road maintenance teams) were selected from the Road Development authority (RDA) only, because the RDA is the major functional road maintenance organisation in Sri Lanka, which operate island-wide. Moreover, the composition of the maintenance team varies based on the maintenance methods adopted. Therefore, this study is focusing on roads only. Direct labour system is the most popular method in carrying out road maintenance in Sri Lanka. In this, an engineer will take a lead role while a number of other personnel such as Technical Officer (TO) and Technical Assistant (TA) involve in the management team. In addition, there are work supervisors (WS) who directly supervise labour gangs. These personnel together belong to one Executive Engineer’s (EE) division. Three such teams were selected from RDA. Interviews were conducted with three key participants of each team; namely, Executive Engineer, Technical Officer (TO) and Technical Assistant (TA). A brief description about the selected three cases is given in Table 1.

Table 1: Brief Description about the Selected Cases

Case	Case A	Case B	Case C
Type	Road maintenance team in RDA-Western province	Road maintenance team in RDA – Southern province	Road maintenance team in RDA – Sabaragamuwa province
Number of km	171 km	287km	273km
Number of Depots	4	3	3
Number of Members	EE - 01 TOs - 04 TAs. - 04 WSs - 11	EE - 01 TOs - 04 TAs. - 08 WSs - 12	EE - 01 TOs - 01 TAs. - 02 WSs - 10
Number of Labours	100	172	106

The interview data were then mapped through cognitive mapping concepts to draw conclusions. These case study findings are presented and discussed next.

4. RESEARCH FINDINGS

Initially, the empirical phase looked into the four maintenance phases and how members work as a team in each phase, starting from the planning phase. The Road Maintenance Manual (Road Development Authority, 1989) highlighted that the Executive Engineer is the key person responsible for the planning, programming, organising and carrying out all operations on road maintenance. However, in the studied cases all key participants act as a team in the planning stage. For example, the Executive Engineer of the Case C stated, “*I personally think that teamwork is very important at the planning stage, because we have limited funds and resources. Hence, we have to select priority items considering the urgency of attending. For that, we have to discuss each and every item. Then only we can perform well*”. This was the case in the execution phase too. Most of the members who were interviewed in the study were in the road maintenance teams for many years and they were well experienced. Almost all the interviewees believed that the team is a must at the execution phase of road maintenance works.

Road maintenance should be carried out while the service is provided to the users. Therefore, testing of work done is carried out at the same time of execution of work. The Technical Assistant of the Case A

explained this, *“most of the time, road maintenance works are tested during the execution. So TO, TA and WS who are at the execution are involved for this testing. EE will involve later to confirm the work is in order.”* Hence, it cannot be seen as a team activity fully. Similarly, the interviewees viewed that feedback is a two-way process rather than a team activity. The Technical Assistant of the Case A mentioned, *“feedback of our team is in moderate level. However, feedback is essential because team members can understand the success level of the work they have done through feedback. Team members always seek team leader’s feedback after most of the work.”* The Executive Engineer in Case A further indicated, *“in my team feedback level is very good up to Technical Assistant level. However, Work Supervisors are not skilled enough for that. However, the member’s feedback is essential for the maintenance work.”* Hence, it is apparent that both parties (leader and subordinate) are expecting feedback from each other’s.

Next, the empirical study looked into team working features in the selected road maintenance teams as discussed next.

Team Composition - Teams studied were quite similar in terms of team composition but vary in size. As per the Executive Engineer in the Case A, *“team consisted of various people who are normally involved in road maintenance activities. My present team consists of Executive Engineer, Technical Officers, Technical Assistants, Work Supervisors and maintenance labourers. This composition is ideal for road maintenance works.”* In some Executive Engineer’s Divisions, there is an additional Engineer to help EE, due to the physical spread of the area under the EE’s Division. For example, EE’s office in the Case B is 106 kms away from the boundary of the EE’s Division. Therefore, to avoid management difficulties, one additional Engineer was allocated. Also, Case B comprised of several TOs to assist the team as some of the non-maintenance works were also assigned to them such as road improvement works.

The empirical study has identified that the road maintenance teams are of varying team sizes. Cases, which were selected in this study, consisted of varied number of team members in both supervisory level and labour level. Case A and Case B have higher number of members in those teams in supervisory level where as, Case C has less number of members in the team. Executive Engineer in Case A noted, *“Actually the size and the structure of the teams are highly influenced, when attending the wide range of scheduled activities. As far as this team is concerned, the structure is ok but the size is not enough. Due to the less attendance of labour less output can be gained.”* In Case C, in which the team size is further less in labour level, its Executive Engineer indicated that the number of labourers in his team should be increased.

Capabilities of the Team - The empirical data disclosed that in road maintenance teams, the capability of team is significantly governed by the competencies and skills of each member. For example, the Executive Engineer of the Case C indicated, *“individual’s capability is very important as road maintenance is a hardworking activity and skill is also required. But in some areas, we cannot get required skills as expected because some team members are not interested to develop their skills.”* Capabilities are important in urgent situations, for example, the Executive Engineer in Case B indicated, *“relevant to the work to be carried out, there should be at least one capable man to do it. If there are no skilled personnel we have to hire people.”*

Leadership within the Team - All the members in the case studies perceived Executive Engineer as the team leader of the team. Most of the interviewees stated that the Executive Engineer as the team leader who coordinated the day-to-day activities, overlooked and supported well for the successive performance of road maintenance. However, it was found that their leadership role is significantly governed by the organisational conditions. For example, the Technical Officer in Case B indicated, *“Team leader and the team have to follow all the financial and administration regulations and conditions, which were declared by the parent organisation. Therefore, there are conditions and limits when implementing the maintenance activities. For procedures of maintenance, we have to follow the guidelines of the RDA specifications. However, some freedom is there within the above limits.”* Therefore, it is evident that in road maintenance teams, the leader’s role was controlled by the organisational conditions up to some extent and hence, the importance of the leadership role on team performance is affected.

Trust within the Team - Generally, teamwork was seen between members. Executive Engineer of Case A further described, *“I think, members do well in their teamwork, because they help each other when one has more work, interchange materials if the other do not have them and so on.”* Trust was highly

regarded in road maintenance teams. Supporting this statement, Technical Officer of Case C stated that *“To develop the maintenance performance, trust between individuals is important, because the team is dispersed and most of the works are material related works. If there is no trust, some malpractices can occur.”* It was observed that Executive Engineer as team leader of road maintenance teams intervened to develop trust between team members, as the parent organisation has no proper mechanisms. Technical Officer in Case A confirmed this, *“actually the team leader is fully devoted to improve trust between team members. He always arranges some social entertainment activities among team members. Through that he believes to improve trust.”* Technical Officer of Case C stated, *“trust cannot be artificially built-up. It should be developed in individual’s mind emotionally based on the behaviour of another party.”* Hence, leader’s qualities and the behaviours had significantly affected building trust between the team and the leader.

Team Communication - Case study findings showed how lack of proper communication mechanisms affected road maintenance activities in certain urgent repairs. This was made further difficult due to geographically dispersed setting. The Technical officer of Case B stated, *“our team, most of the time, dispersed within some considerable area under road maintenance, which is not like other machine or building maintenance. So the communication is quite difficult.”* However, interviewees agreed that they generally followed the proper channel of communication. Almost all the members highlighted that the behaviours and attitudes of team members affect communication within the road maintenance teams. For example, age of the members, educational background and family background found to have an effect on how they communicate, especially when extending to labourer’s level.

Training and Development - The teams highlighted this area as needing attention. Most of the members who were interviewed in this study have positive interest to participate in training programs, but the parent organisation had not paid much attention to arrange field-training programs at least for the Executive Engineers. Due to the unavailability of Executive Engineer camps, they do not have opportunity to discuss their problems and achievements. Therefore, there is lack of consistency between EE’s divisions in terms of procedures and policies. Thus, different divisions face a similar problem in different ways. Therefore, the need for keeping past records and sharing experiences were highlighted by the empirical study. All above findings are summarised in Figure 1 to depict holistically the key findings from the case studies. The next section put forth key conclusions of this study.

5. CONCLUSIONS

The aim of this study was to explore how team working takes place in road maintenance functions and how to improve this towards sustainable road maintenance in Sri Lanka. This was approached through studying three case studies from Road Development Authority in Sri Lanka. The empirical findings revealed that the process of road maintenance is fairly a cyclical process where maintenance execution and functional testing phases are overlapping. Even though, the process of road maintenance was carried out by teams, there were some phases such as planning and functional testing where not all the members needed to involve. However, it was noted that the key members were involved, in particularly at the planning phase. Further, it was also evident that the team involvement is necessary in the execution phase.

Team members in road maintenance teams depicted good team working especially in emergencies. It was evident that in the selected road maintenance teams, even if they do not have enough members, at emergencies, they could manage such situations favourably due to collective efforts. Generally, these teams were quite similar in team composition with very few key members at the supervisory level. Even though, the Executive Engineer was considered as the leader of the team, his role was significantly governed by the organisational conditions and regulations. Nevertheless, most of the leaders have taken efforts to play their role to enhance team performances by supporting, coordinating, facilitating and keeping good relationship with members. To this extent, building trust within the team was highly regarded by the leaders and the other team members. In terms of communication, despite fewer facilities most of the teams followed proper channels. Team dispersion was seen as the most influential barrier while age, educational and family backgrounds also affected communication within road maintenance teams. Further, lack of field training was highlighted by the case study participants and need for

consistency in terms of practices and procedures in between different maintenance teams within the same organisation.

Based on above key findings following can be recommended for better team working practices in road maintenance activities. It is also important for the road maintenance team leadership to be knowledgeable about the process of road maintenance and determine what type of resources and support will be required to the team based on the specific challenges faced in each phase. Support from organisation level for team building activities is seen as important as individual teams and leaders are conditioned by organisation rules and policies. In particular, more opportunities for knowledge sharing are important, as there was less connection between different teams who encounter similar problems. To this end, recording lessons learned and wider dissemination of these at organisational level and knowledge building through training and development are also highly relevant. Hence, future studies could look into knowledge sharing opportunities between different road maintenance teams

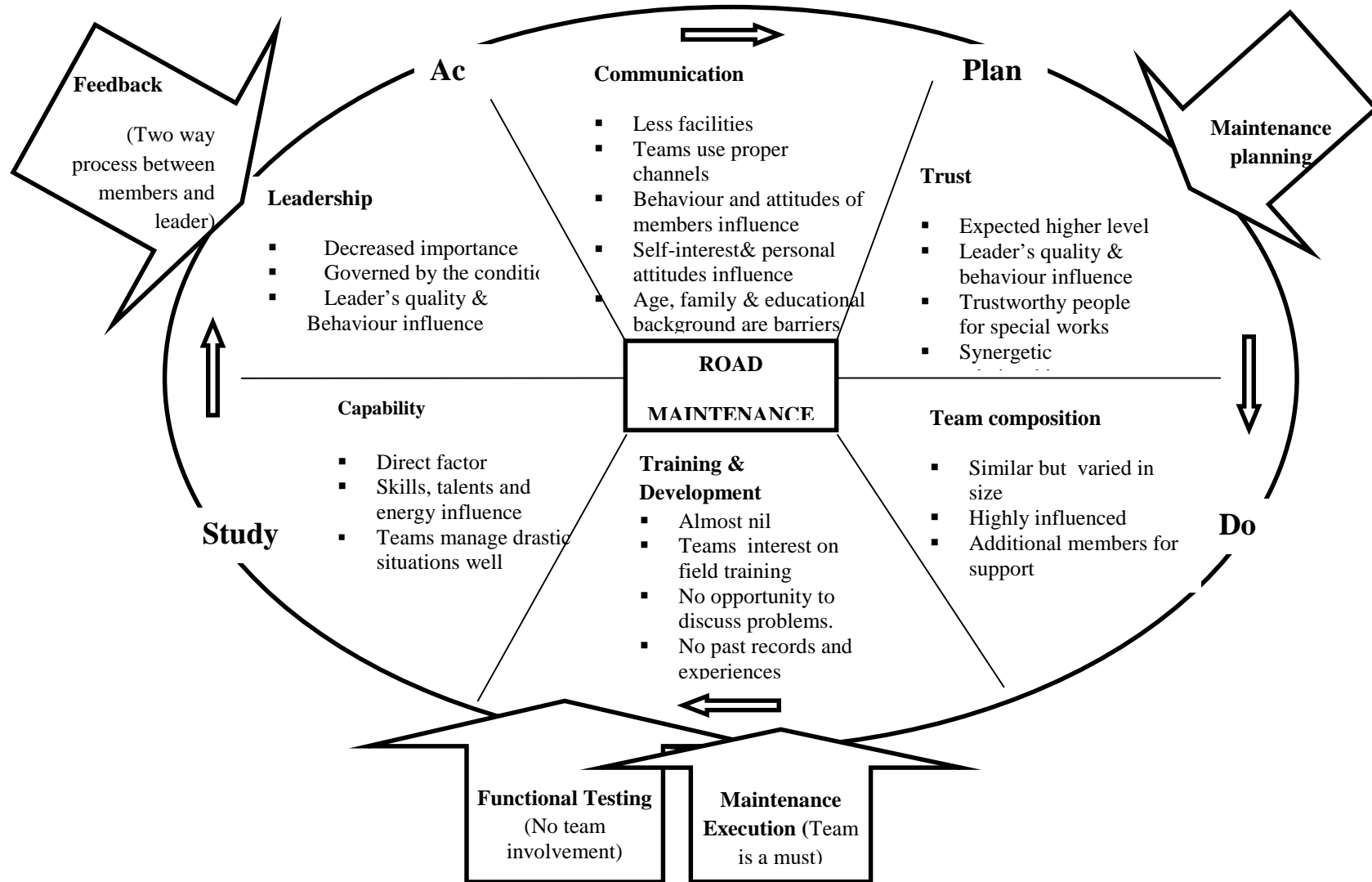


Figure 1: Road Maintenance Team Performance Process Based on Case Studies

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