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Prioritizing Key Business Actions of an Indian Automobile Industry Using Efficient Interpretive Ranking Process (eIRP)

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Abstract
Management processes in an organization involve decision-making based on many criteria (MCDM), and in this process ranking of variables plays a vital role. This paper presents the analysis of key business issues of an Indian automotive organization using an efficient interpretive ranking (eIRP) approach. This paper integrates the Situation-Actor-Process (SAP) and Learning-Action-Performance (LAP) framework of the organization with eIRP. It evaluates the ranking of actions to be carried out in an organization with respect to performance parameters. The study highlights the area where the organization should focus on achieving desired business excellence. From the analysis, it is revealed that the top-ranked suggested action for the organization is the adoption of energy policy as a core business policy followed by technology management, maintenance management, and the use of information technology for cost management. This case study is one of the few that uses the SAP-LAP framework for ranking the actors and actions of the organization using the eIRP approach, to make MCDM an easy task.

Keywords
Multi Criteria Decision Making (MCDM), system flexibility, SAP-LAP, eIRP, business excellence, cost management.

Introduction

An organization's company excellence can be looked at in terms of competitive high-quality levels, increased productivity, cost efficiencies, and higher customer satisfaction together with decent customer retention and great customer loyalty. The drive towards business excellence entails an intricate decision-making procedure. Planning and Decision making (Multi-criteria) is the essential step of any business excellence philosophy and so the ranking of variables. The ranking can be carried out by the investigators and professionals for assigning factors like critical success factors, barriers, risk factors, etc. The authors (Talib and Rahman, 2010), proposed a framework comprising CSFs for implementing the TQM in the service industry. In this study, the authors ranked the CSFs based on the frequency of their use by researchers and practitioners. The authors (Kumar et al., 2011) in their study also ranked the CSFs for implementing TQM in the Indian scenario, but the authors adopted the TOPSIS approach to rank the CSFs. The authors (Talib and Rahman, 2015) in their study, adopted the analytic hierarchy process (AHP) approach for prioritizing the barriers of TQM implementation.

The authors (Kumar et al., 2011) in their study, identified and ranked CSFs responsible for implementing TQM in north Indian manufacturing and service industries. The authors presented the variation in the ranking of the CSFs for manufacturing and service industries. The business excellence drive is a continuous improvement process and there are many strategies for continuous improvement, so the authors (Sraun and Singh, 2017), ranked the various strategies i.e. TQM, JIT, leadership, TPM, CR, system core work, TEI, supplier development for achieving business excellence. The authors ranked total quality management at the top position among the others. The authors (Ojha et al., 2014) in their work, studied the critical factors affecting manufacturing excellence using interpretive structural modeling. The ranking techniques can be broadly classified as quantitative or qualitative techniques. These

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techniques/tools have their own merits and demerits. The quantitative tools employ a suitable scale for ranking the variables whereas the qualitative tools employ subjective interpretation by an expert about the variables for ranking (Sushil, 2012). The quantitative ranking tools most of the time do not carry forward the clear-cut distinction between the scaling numbers to a responder whereas qualitative tools provide the same essence of the ranking parameter to the responder but judgmental in nature. Both ranking approaches are more suitable to address the flexibility (freedom of choice) of the system. The flexibility of the system involved in decision-making makes the process more complex.

This paper concentrates on the use of qualitative tools to address system flexibility. The interpretive structural modeling (ISM), total interpretive structural modeling (TISM), and SAP-LAP, etc. are some qualitative tools used to address the flexibility of the system (Sushil, 2000, 2001, 2009b). The flexibility gaps of a managerial situation can easily be identified using the SAP-LAP framework (Sushil, 2000). Many authors had adopted the SAP-LAP framework for multi-criteria decision-making. A brief literature survey about the application of the SAP-LAP is presented in the following paragraph.

This framework has been successfully applied to study the supply chain issues (Arshinder, 2007; Banwet and Pramod, 2010; Shukla et al., 2011) of the organization. A case of humanitarian supply chain management, involving supplies, information, and services to reduce disaster to mankind, was studied using the SAP-LAP framework (Lijo, 2012). The author (Parikshit, 2012) in his work addressed both qualitative and quantitative issues in the supply chain of an automobile company using the SAP-LAP framework. A study was carried out by the authors (Kumar et al., 2018) to analyze the supply chain of coal transportation systems using the SAP-LAP analysis.

A study on the overall role of product flexibility in providing sustainable growth to the organization using the SAP-LAP approach was presented by the authors (Shalender and Singh, 2014). The issues affecting the managerial turnover in a sociotechnical system of an organization were also addressed by the SAP-LAP framework in a study presented by the authors (Ghosh and Sahney, 2010). The flexibility issues in the maintenance program for resolving the engineering support issues were studied by the authors (Garg and Deshmukh, 2010) using the SAP-LAP framework. This approach had cast its role in addressing the flexibility in sustaining business excellence (Breja et al., 2010). The issues of strategic technology management and implementation of lean manufacturing in the automobile industry were addressed by the SAP-LAP analysis (Chauhan and Singh, 2013; Sahoo et al., 2011). The authors (Matharu and Sinha, 2019; Palanisamy, 2012), worked on the lean implementation and building information system for SMEs using the SAP-LAP framework. An SAP-LAP framework-based study was conducted on the service quality provided by technical institutions located northern India by the authors (Gupta et al., 2019). The urbanization trend in India to determine whether it has enough resources to sustain a growing urban population was analyzed using the SAP-LAP framework (Chavan et al., 2019). The authors (Venkatesh et al., 2014) in their study highlighted the supply chain issues of an apparel industry with the help of the SAP-LAP approach.

A decision-making process is pivoted about the ranking of variables (Sushil, 2009a). Interpretive Ranking Process (IRP) makes use of an interpretive knowledge base formulated in the form of a matrix (Sushil, 2009a). The key success factors needed for the implementation of world-class manufacturing were ranked using the IRP approach, the ranking model was based on the interpretive structural model (Haleem et al., 2012). The complexities involved in the design of networks for the green supply chain promoted the authors (Mangla et al., 2014) to investigate the involvement of the risk mitigation strategies. The authors build the framework on the SAP-LAP and ranked the variables using IRP (Mangla et al., 2014). The lean implementation enablers of the manufacturing sector were modeled and ranked using ISM & IRP approaches by the authors (Sharma et al., 2016). Since, the implementation of lean is a difficult task as it has many barriers, (Zhang et al., 2017) adopted an interpretive ranking process to rank the barriers hindering the lean manufacturing implementation. The authors (Hughes et al., 2017) studied the key factors responsible for the failure of Information Systems (IS) projects using the IRP approach. The authors (Narkhede et al., 2017) in their work, adopted the interpretive ranking process (IRP) to find out the rankings of factors and their mutual influence in the selection process of third-party logistics service provider (3PLSP). The authors (Mhatre et al., 2017) in their study, carried out the modeling of CRFs for the construction project with the help of IRP and system dynamics (SD) approach. The authors (Sushil, 2019) presented an efficient IRP (eIRP) approach capable of reducing the number of paired comparisons making it suitable for problems with a large number of variables. The researchers (Malik et al., 2019) carried out an analysis of the financial situation of India. The researchers adopted an efficient IRP to rank actors of the Indian economy. The authors (Parameswar et al., 2020) applied the integrated TISM-IRP approach to study the choice of interaction of International Joint Venture (IJV) parent firms after the termination of the IJV. The authors (Kumar and Anbanandam, 2020) developed a model for evaluating the freight transportation system in India using SAP-LAP and eIRP approach.

This paper presents a study about the evaluation of key business excellence issues of an organization. The research was conducted in the following two stages and this paper presents the 2nd stage.

1. Development of SAP-LAP framework of the organization for the select key business excellence issues (Kumar and Gupta, 2020).
2. Ranking of key business actions of a framework using the efficient interpretive ranking process (eIRP) approach.

This paper adopts a SAP-LAP framework developed by (Kumar and Gupta, 2020) for carrying out the ranking analysis using eIRP approach. (Kumar and Gupta, 2020)

Research gap

The above literature review shows that there exists a limited number of case studies that involve the ranking of business actions for the excellence of the organization using a qualitative technique in contrast to the studies conducted by employing quantitative tools.

Objective

Based on the above research gap, the objective of this manuscript is to present the ranking business actions model using an interpretive qualitative approach eIRP.

About the organization

The organization ABC Ltd. (name changed to protect privacy) has been an Indian automobile manufacturer since 1994. It manufactures medium and commercial vehicles. The organization has introduced several new technologies and innovative products in the Indian as well as other markets. The organization is determined to design, develop, manufacture, and market independently its commercial vehicles as per customer needs. The market share of the organization is 31.2% in M&H commercial vehicles in India in FY19. The company registered a revenue of USD 2 billion in the FY19.

Methodology

In the SAP-LAP framework of the organization, self-interaction and cross-interaction between the elements in the form of binary as well as interpretive matrices were used to study the interactions. These interactions resulted in the development of the knowledge base in the form of learnings, actions, and suggested performance parameters. The linkages among the elements of the framework are analyzed using eIRP. eIRP is an MCDM process involving interpretive paired comparisons. The key elements of the SAP-LAP framework of the organization are presented in Table 1. There exist many paired com-

Table 1
Elements of SAP-LAP framework

Components	Elements
Situations	S1: *High inflation*
	S2: *High power cost*
	S3: *Old machines and plant*
	S4: *Wide range of product*
	S5: *High manpower cost*
Actors	A1: *Government of India*
	A2: *Top management*
	A3: *Cross-functional management*
Processes	P1: *Strategic Planning*
	P2: *Quality assurance (QA)*
	P3: *Cost management (CM)*
	P4: *Human resource management (HRM)*
	P5: *Energy management*
Learnings	LN1: *Global vision of the organization*
	LN2: *Technology up-gradation*
	LN3: *MUDA reduction program*
	LN4: *Capacity enhancement/Efficiency improvement*
	LN5: *Liaison with alternate energy resources*
Actions	ACN1: *Energy policy as a core objective*
	ACN2: *Maintenance policy*
	ACN3: *Technology Management*
	ACN4: *Use of IT in cost management*
Performance	PP1: *Productivity improvement*
	PP2: *Quality improvement*
	PP3: *Power consumption reduction*
	PP4: *Total conversion cost reduction*

parisons in the framework, we limit our analysis to cross-interaction between suggested actions with performance. The above interactions are chosen to identify the dominant actors and actions that influence the process and performances respectively. This eases the task of prioritizing the action for the business excellence of the organization.

The various steps involved in the interpretive ranking process adopted from (Sushil, 2009a) are listed below.

1. Identification of ranking variables (X) and reference variables (Y).
2. Meaning of the in-context relationship between ranking and reference variables.
3. Identification of interactions of ranking variables (X) with reference variables (Y) (binary matrix).
4. Interpretation of interaction matrix (interpretive matrix).
5. Pairwise comparison of ranking variables interactions w.r.t reference variables to identify dominance matrix (interpretive logic – knowledge base – dominance interaction matrix).
6. Summarize the count of dominant interactions (with/without) weightage to the reference variables and computation of ranks (dominance matrix).
7. Validation of ranks: internal validity; cross validity; sensitivity analysis.
8. Graphical representation of ranks.
9. Decision, interpretation and recommendation.
10. Knowledgebase for further improvement and future use.

Identification of variables

This step involves the identification of ranking variables (X) and reference variables (Y) from the already developed SAP-LAP framework. In the present case, the identified actions of the organization i.e., ACN1, ACN2, ACN3, and ACN4 are the ranking variables (X). These ranking variables are ranked for the reference variables (Y). The performance PP1, PP2, PP3, and PP4 are the reference variables (Y) from the study (Table 1).

Contextual relationship between ranking and reference variables

The in-context relationship between the various ranking variables and reference variables is presented below. Table 2 and Table 3 shows the contextual relationship between the actions and performances in binary and interpretive form.

Table 2
Cross-interaction matrix for actions and performance-Binary matrix

Learning				
ACN1	0	0	1	1
ACN2	1	0	0	0
ACN3	1	1	0	0
ACN4	0	0	0	1
Performance	PP1	PP2	PP3	PP4

Table 3
Cross-interaction matrix for actions and performance-Interpretive matrix

Learning				
ACN1	–	–	Cost-saving	Reduced total conversion cost per unit product
ACN2	Improves plant OEE	–	–	–
ACN3	Improved productivity	Improves human error prevention	–	–
ACN4	–	–	–	Reduced total conversion cost per unit product
Performance	PP1	PP2	PP3	PP4

Dominance matrix: Paired-wise comparison

This step involves the paired comparison of ranking variables w.r.t to reference variables one by one, i.e., action ACN1 and ACN2 are compared for the performance PP1, PP2, PP3, and PP4 respectively. The Dominant interactions and their logic among the actions w.r.t various performance is recorded in Table 4. The above-paired comparison involves the comparison of the interactions among the variable for a particular criterion. All the dominating interactions are Tabulated in the dominating interaction matrix Table 7 (Appendix I).

Table 4
Paired comparison with interpretations of ranking of actions w.r.t performance

Paired comparison	Interaction with performance	Interpretive logic
ACN1 – ACN2	PP3	Energy policy (New energy-efficient machines) reduces maintenance costs.
	PP4	New energy-efficient machines will help in reducing the maintenance budget.
ACN1 – ACN3	PP3	Energy policy provides guidelines for the purchase of new machines under technology management
	PP4	Reduced energy cost helps in reducing total conversion cost.
ACN1 – ACN4	PP3	Energy policy helps in cost saving
	PP4	Help in reducing total conversion cost per unit product by reducing the power cost.
ACN2 – ACN1	PP1	A maintained machine improves OEE.
ACN2 – ACN3	PP1	Maintenance policy contributes to technology management.
ACN2 – ACN4	PP1	Maintenance policy improves the availability of machines.
ACN3 – ACN1	PP1	Adopting new energy-efficient machines reduces energy consumption.
	PP2	Adopting the latest technology machines prevents human error.
ACN3 – ACN2	PP2	ACN2 is not having any direct role.
ACN3 – ACN4	PP1	Technology management enhances productivity.
	PP2	Better technology means improved quality.
ACN4 – ACN1	PP1, PP2, PP3	ACN1 does not have any direct role.
ACN4 – ACN2	PP4	Better track of the associated cost
ACN4 – ACN3	PP4	Better track of the associated cost

Identification of types of dominance interaction

The dominance interaction of one alternative (i) over the other alternative (j) for a criterion can be identified as follows from a binary cross interaction matrix if:

1. Implicit dominance: This type of dominance interaction occurs when an alternative (i) is having a relationship ('1' entry) and alternative (j) has ('0' entry) for a positive criterion, then the alternative (i) implicitly dominates the alternative (j) for the positive criterion and vice versa in case of negative criterion.
2. Implicit non-dominance: This type of dominance occurs if both (i) and (j) cells have no relationship ('0' entries). This can also happen if both the (i) and (j) cell have a relationship ('1' entries) and interpretation is the same in both the cells, there exists implicit non-dominance and then enter '0' in in the $i{-}j$ cell.
3. Interpretive dominance: when both the (i) and (j) cells have a relationship ('1' entries) and interpretation is different in both the cells, then the dominance is decided by an external expert with proper justification of dominance in the knowledge base.
4. Transitive dominance: This type of dominance occurs when there exists '1' in more than two cells for a particular criterion i.e., i, j, k having varying interpretations. Then if $i{-}j$ is a dominant interaction and so the $j{-}k$, the $i{-}k$ will be transitive dominance. The above steps are repeated for all the dominating interactions.
5. Calculate the overall dominance matrix by summing all possible dominance interactions.
6. Calculate, the number of all paired comparisons with their respective percentages, Table 5.
7. Calculate the rank of a variable using Dominance Index (Sushil, 2020). For calculating Dominance Index, calculate net dominance (ND) by subtracting No. of being dominated from no. of dominating (D–B), Table 6. Then calculate adjusted net dominance (AND) to convert negative values of net dominance into positive values. At last, the Dominance index is computed by equation (1).

$$\mathrm{DI}_x = \left(\frac{\mathrm{AND}_x}{\text{Total Interaction (TI)}}\right) \times 100. \qquad (1)$$

Based on the above index, the ranking of variables is calculated and shown in Table 5 and Table 6.

Table 5
Different types of dominance comparison for action x performance

Reference variables	Implicit dominance	Implicit non-dominance	Transitive dominance	Interpretive dominance	Total comparison	% Interpretive comparison
PP1	4	2	0	0	6	0.00
PP2	3	3	0	0	6	0.00
PP3	3	3	0	0	6	0.00
PP4	5	1	0	0	6	0.00
Total	15	9	0	0	24	
Percentage	62.5	37.5	0.00	0.00		

Table 6
Dominance matrix – ranking of actions w.r.t performance

	ACN1	ACN2	ACN3	ACN4	No. Dominating (D)	Net dominance (D–B)	Adjusted net dominance (AND)	Dominance index (DI)	Rank dominating
ACN1	–	2	2	2	6	3	6	37.5	I
ACN2	1	–	1	1	3	–1	2	12.5	III
ACN3	2	1	–	2	5	1	4	25	II
ACN4	–	1	1	–	2	–3	0	0.00	IV
No. of being dominated (B)	3	4	4	5	16 Total interactions				

Discussion

The following section discusses the type of dominance interaction that evolved from the analysis.

Actions X Performance

Based on the binary and interpretive matrices shown in Table 2, Table 3, and interpretive logic-knowledge base presented in Table 4, the various possible interaction types are shown in Table 5. In this case, implicit dominance comparison was highest with (62.5%) followed by implicit non-dominance (37.5%). Both the implicit non-dominance and interpretive dominance were not observed in the analysis. The minimization or absence of interpretive dominance is the main feature of the efficient interpretive process (eIRP). Table 6 shows the dominance matrix for ranking of actions w.r.t performance. Action ACN1: Energy policy as a core objective tops the ranking position among the others with a dominance index of 31.57%.

The organization was facing serious issues on energy consumption, a considerable part of its turnover was spent on energy, it is a must for the organization to formulate policies on energy management and include it in its core business policies. Action ACN3: Technology Management is in the second position with a dominance index of 21.05%. The organization was in desperate need of new and better energy-efficient machines. the old machines were the energy guzzlers and prone to frequent breakdown. Action ACN2: Maintenance policy is in third place with a dominance index of 10.52%. The organization needs a maintenance policy as a core excellence policy to minimize the cost due to loss of production. Action ACN4: Use of IT in cost management is in the fourth position. The use of information technology in cost management will help the organization to keep track of all the associated costs in a well-organized manner.

Conclusions and practical implications

This study presents the contribution of the SAP-LAP framework in building the interpretive knowledge base and ranking of elements of the framework with the help of eIRP. The SAP-LAP framework developed for the business excellence of an organization (Kumar and Gupta, 2020) was adopted for establishing the interpretive linkage among the SAP–LAP elements with the help of eIRP. Further, we can explore other possible interactions between other elements of the empirical model (Sushil, 2009a; 2009b). This study is focused on cross-interaction matrices between key business actions and performance parameters. The study revealed that the potential actions are Energy policy, Technology management, Maintenance management, use of IT in cost management plays a significant role in improving the business excellence of the organization. The results of this study can be utilized to manage various actions of the organization. This study also offers many policy implications that can exist in an organization irrespective of its sector. The SAP–LAP framework portrays an overall picture of the various situations present in the organization in an interpretive and organized manner. The ranking of actions will add the policymakers in improving their multi-criteria decision-making and building key strategies for their business excellence. It is always the role of the top management to formulate the policies for both long and short goals considering global and domestic aspects. The ranking model can be validated by checking the net sum of all the dominances for all the variables and it should be zero as in the present case (Table 6). The internal validity of the ranking model shown in Fig. 1 (Appendix I) is depicted by dominance system graphs shown in Fig. 2 (Appendix III). Table 8 to Table 9 (Appendix II) presents the dominating interaction matrix of actions for various performances.

This study can be informative to the readers in the sense that it provides a holistic approach for decision-making in a situation that involves multiple criteria. This study also has some practical implications, as this study was based on a single organization situation with limited expert opinions. Therefore, the results might differ when we apply the model to another organization. For the generalization of the results more empirical data should be gathered. Also, the model needs to be reframed before implementing in varied situations.

In the future, this model can be tested for implementation in an organization with certain modifications also coding can be done to automatically compare the factors. The authors want to acknowledge the team of ABC ltd., experts, and others who have contributed directly and indirectly to the development of the study. The author(s) also declare that there is no conflict of interest.

Appendix I

Table 7
Dominating Interaction matrix, ranking of actions w.r.t performance

		Dominating			
		ACN1	ACN2	ACN3	ACN4
Being dominated	ACN1	–	PP3, PP4	PP3, PP4	PP3, PP4
	ACN2	PP1	–	PP1	PP1
	ACN3	PP1, PP2	PP2	–	PP1, PP2
	ACN4	–	PP4	PP4	–

eIRP model of actions w.r.t to performance.

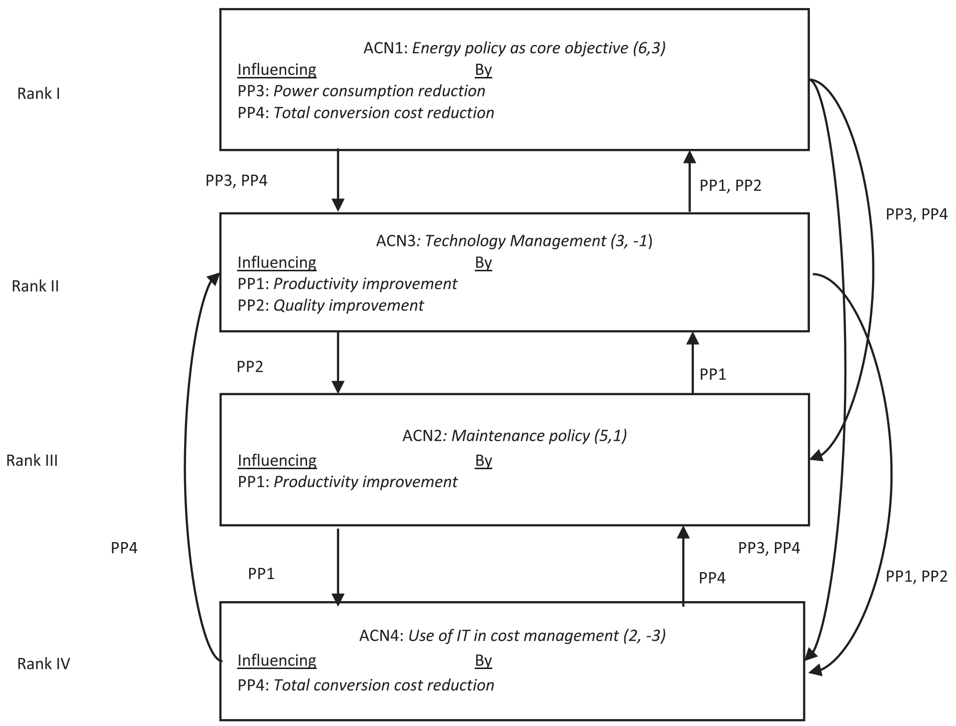

Fig. 1. Interpretive ranking model of action w.r.t performance

Appendix II

Table 8
Dominating interaction matrix of action for performance PP1

	ACN1	ACN2	ACN3	ACN4	
ACN1	–	–	–	0	For PP1
ACN2	1	–	1	1	
ACN3	1	–	–	1	
ACN4	–	–	–	–	

Table 9
Dominating interaction matrix of action for performance PP2

	ACN1	ACN2	ACN3	ACN4	
ACN1	–	0	–	0	For PP2
ACN2	–	–	–	0	
ACN3	1	1	–	1	
ACN4	–	–	–	–	

Table 10
Dominating interaction matrix of action for performance PP3

	ACN1	ACN2	ACN3	ACN4	
ACN1	–	1	1	1	For PP3
ACN2	–	–	0	0	
ACN3	–	–	–	0	
ACN4	–	–	–	–	

Table 11
Dominating interaction matrix of action for performance PP4

	ACN1	ACN2	ACN3	ACN4	
ACN1	–	1	1	1	For PP4
ACN2	–	–	0	–	
ACN3	–	–	–	–	
ACN4	–	1	1	–	

Appendix III

Internal Validity for Pair-wise Comparison of Actions (ACN_j – ACN_k) through Dominance System Graphs for Various Performance (PP_i)

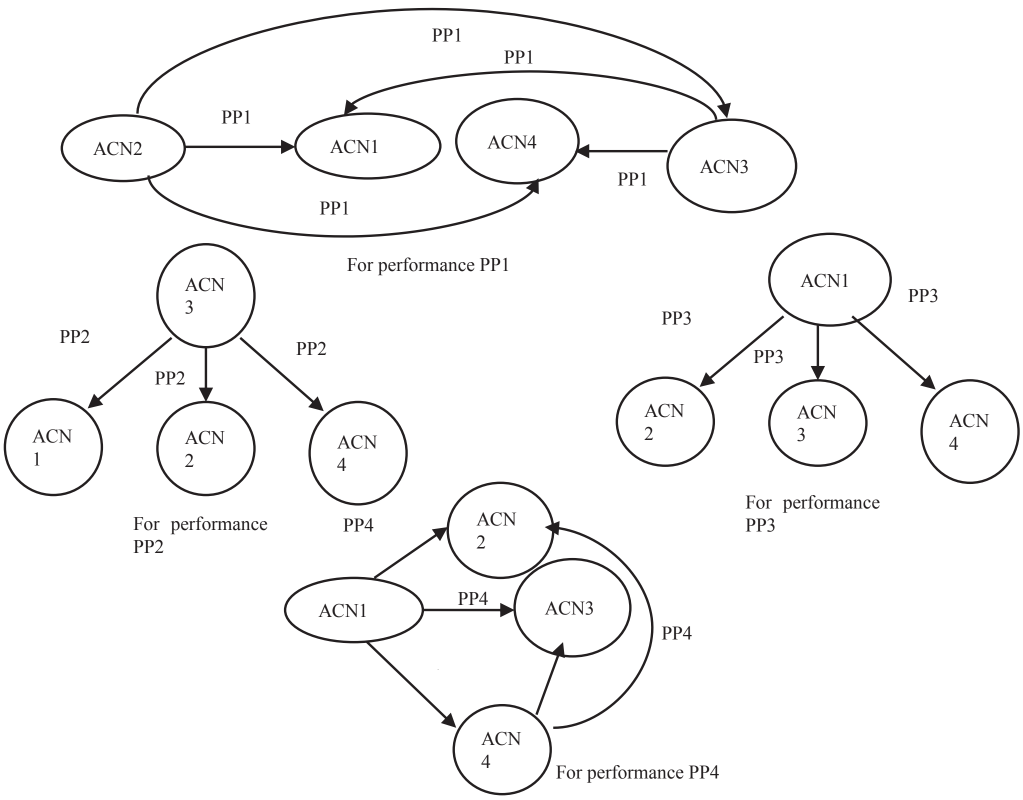

Fig. 2. Internal validation for actions

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