Assessing Project Performance with Uncertainty

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Abstract: Organisations are looking ways to improve their bottom-line and thrive against their competitors. However, modern organizations are extremely complex. Setting improvement targets too high without considering the company's capability and its external and internal interactions will have little chance of achieving the set targets, which means project failure. Resource limitations often dictate the ability to work on improvement projects. Prioritization of projects is essential to sustain the trend of process improvement. This paper describes a risk model that integrates performance prediction with organisational capability score and level of difficulty to assess the likelihood of meeting performance gain targets. The risk assessment outcome indicates to the company when and where organisational capabilities need to be adjusted in order to maximise the chance of success.
Keywords: Project performance; organisation capability; performance effectiveness; performance risk assessment

1 INTRODUCTION

Organisations are looking to make improvements that increase their operational performance with the expectation of increasing their bottom-line and ability to survive and thrive against their competitors. They may determine a number of actions or projects to improve their processes and ultimately their performance. Resource limitations often dictate the need to prioritise process improvement (PI) projects to select those few projects that can provide meaningful benefit when weighed against the level of effort required to achieve them. Various techniques and methods are utilised to perform this prioritisation process. Many organisations working with PI first look for the 'low hanging fruit' projects. Shi et al. [1] surveyed 148 Chinese toy makers and gave constructive and practical suggestions for improving the manufacturers' performance. Quarterman [2] defined PI projects as those appeared to be very quick and easy to implement. Given these PI actions, higher priority would have a better chance of success. Methods considering low hanging fruit ideas are available such as Lanza [3] who proposed starting with low-hanging fruit by initially set priorities on fifty suggestions that provided the most benefit for the least effort expended and presenting a subset of this list as the most important. Grant [4] suggested selecting projects that are significant and urgent to the business and which can be analysed simply allowing staff to be trained in and use simpler analysis tools to perform the analysis themselves. Hanenkamp [5] defined a generic process reference model that focused on prevention, frequent high decision making and empowered teams consisting of experts, managers and operators.

The research by Shukla [6] analysing organisational historical performance data of PI projects showed that organisational behaviour could be placed in two categories: reactive and proactive management. In reactive management improvements were based on the need to reduce or remove a past deviation, which were referred to by Shukla as low-hanging fruit. After achieving reactive process improvement in reactive mode, the difficulty in the project increased to a level that reactive management would be insufficient to achieve desired PI outcomes. The organisation behaviour would need to be proactive

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management of process elements, reactive management of people, and proactive management of people. However, a problem faced by almost all organizations seeking improvement was the constant demand for high performance (Swanson, [7]). Managers were left with the task of dissecting and interpreting each situation they faced. Without the guidance of performance improvement theory, they were in a trial-and-error mode prioritising PI actions.

However, the prioritisation and selection of PI projects, actions and initiatives based on low levels of difficulty does not automatically guarantee success. An organisation exhibiting low level of capabilities such as including lack of focus, management disengagement and low incentive for improvement will find any PI initiatives hard to push through the enterprise system. They may fail to sustain even simple improvement actions and performance gains.

Mabin and Balderstone [8] concluded organisations reporting considerable gain from PI may have an overweight of projects of low hanging fruit projects. It could be conjectured this situation is in due in part to lack of appropriate knowledge of the risks involved. The default position in this case of minimal risk understanding may be to only take easy projects even though sizeable gains are available from more difficult projects requiring higher levels of effort to succeed. Baumgartner [9] found that ambitious corporate sustainability activities and strategies have to be embedded in the organizational culture in order to be successful. The research characterised four corporate sustainability strategies and assessed the integration of organisational culture of a mining company in three levels.

A weakness with these methods is the lack of an objective estimate of the probability of success (PoS) of achieving the desired performance gains. Completing a PI project is the starting point of long term development. For organisations with a low level of capability and focus even small and relatively simple gains may be difficult to initially achieve and then sustain into the future. The knowledge of PoS prior to the commencement of a PI project will help to mitigate the risks of not achieving the desired improvement outcomes and wasting the opportunity of securing improvement from other areas. The PoS estimate indicates that if the risk of PI project failure is too high actions decisions such as increase of capability, modification of scope or even postponement or cancellation may result. Without PoS knowledge projects may be commenced with little chance of success and subsequently fail with possible negative consequences such as recriminations, disappointment and disillusionment with PI. A method is required to include a calculation of the PoS when evaluating and prioritising a set of PI projects. This paper intends to full the gap by developing a new functional relation between the organisational capability and the potential performance of the PI project outcomes. The method is illustrated and validated using a PI improvement case study in a medium sized manufacturing company in Australia.

2 LITERATURE REVIEW

Many researches have been conducted to determine appropriate and adequate PI project prioritisation in order to improve the chances of PI success. Banuelas et al. [10] found the most popular tools and methods used for prioritising PI projects within a six-sigma framework are cost-benefit analysis, cause and effect matrix, and Pareto analysis. Other methods and tools such as non-numeric methods, practical process improvement (PPI), theory of constraints (TOC), unweighted scoring models, and analytic hierarchy process (AHP) have also been used to a lesser degree. Further explanation of these techniques is found in Marriott et al. [11]. However, these methods only focused on the benefits and impact of the PI projects but did not take into account the difficulty to achieve the desired performance gain results. The effect of ignoring the project difficulty was reflected in high failure rates (Poba-Nzaou et al. [12]).

The concept of analysing and ranking PI projects according to project difficulty should be supported by appropriate decision support methodologies. Componation & Farrington [13] studied 16 continuous process improvement teams working in different industries and concluded that they would require different tool sets than traditional project teams. In particular, the difficulty-impact grid problem solving tool provides support to continuous process improvement teams. Chakravorty [14] used Benefit and Effort (B&E) Analysis to prioritise PI projects. The B&E anlaysis could be used for prioritising problems or upscaled to include a more detailed benefit and effort estimation for each project or action based on a weighted sum of factors considered relevant to the organisation. This estimation could be relatively simple as selecting a single number on an integer scale representing a general opinion of benefit and effort. In addition, B&E analysis could be more complex in nature with a detailed specification for each of a hierarchy of factors. Such a hierarchy of factors could be used in a multi-criteria decision analysis (MCDA) model using for example the Analytic Hierarchy Process (AHP) by Saaty [15].

Adesola & Baines [16] created a holistic workbook-based methodology with relevant tools and techniques to support the implementation of business process improvement. Their methodology extended the existing model-based tools to include the process prioritisation matrix representing the rating of difficulty as a criterion. Dismukes [17] developed a methodology, based on factory level productivity metrics, and took into account overall equipment effectiveness and material flow, that could evaluate and prioritise possible losses and variations of the PI projects. Effectively, this was a simulation tool assessing various improvement scenarios from which management could decide which PI project to pursue. Reyes et al. [18] investigated optimisation of software development using a genetic algorithm to propose a cost effective investment of project resources to improve the probability of project success. The optimization method was tested with several software risk prediction models to predict the probability of success of a project based on the activities undertaken by the project manager and development team. However, the complexity of this method was suitable for software based projects but would preclude its use in general PI projects.

Antony, Kumar and Labib [19] suggested when selecting PI projects care should be taken to prioritise projects with a high PoS. Clearly if PoS was to be used as the single prioritisation criteria or one of several prioritisation criteria a method is required to estimate it. Methods to improve the PoS of PI projects can be divided into several types. Abe et al. [20] employed a method of prioritising software projects using Bayesian Classifiers and defined 'leave one out' cross-validation. Success was defined in terms of quality, cost and duration. The success prediction accuracy of the method for projects executed with in a single company exceeded estimation by experts but had a high dependency on the capability metrics chosen. In selecting R&D projects for a portfolio. Davis et al. [21] provided PoS estimates for success factors based on association of numerical probabilities of success on an ordinal 1-5 scale to a probability scale. Probability of success evaluations were made by an expert committee. Alternatively a user was encouraged to associate PoS values based on their personal experience. Unfortunately, this method only considered relative PoS with no estimate in terms of quantitative likelihood of success.

It is therefore important that a method that not only quantifies the probability of success or odds of success for particular PI projects or PI actions, but also assesses the level of difficulty that such PI projects would impose onto the organisation. Nicholds & Mo [22, 23] developed the concept of relative performance effectiveness which provided a means to readily assess the capability of the organisation in carrying out specific PI projects. The function S_C could take into consideration a broad range of factors within the organisation and compare against the internal situation at the time of planning the PI projects. These measures could be obtained from historical data as well as stakeholder judgement. This paper extends this concept to map performance effectiveness to include consideration of the difficulty in executing the project. A novel method of assessing the relationship of performance to the performance effectiveness factor is introduced to integrate the actual performance to the capability of the organisation.

3 LINKING PERFORMANCE TO CAPABILITY

Performance P is to be predicted based on a measure of PI capability of an organisation to implement a PI project and obtain performance gain from it. The level of performance gain achieved by a PI project can be defined in verbose scales such as inadequate, good, very good, excellent, etc. For more clarity, most managers would like to use an exact quantitative scale such as a value between 0 to 100.

When attempting to predict performance gains from PI projects it is problematic to compare performance gain between PI projects in terms of interval or ratio scales and diverse engineering and scientific units. Comparison of performance scale often depends on common understanding or interpretation of the maximum and minimum values of the scale. For example, a process may have a performance level of 45 in a scale of 0 to 100, but from descriptive perspective this would be considered 'good' while for another process this performance level may be rated 'inadequate'.

In the study of a small manufacturing company, Nicholds and Mo (2012) proposed a model to describe the capabilities within the companies in a quantitative measure. A company has a perfect capability score of 100% if every single element of the 3P subsystems matches exactly what the PI project requires. However, this is an ideal case. The reality is companies will have varying levels of capabilities and the capability score will fall somewhere between 0% and 100%. From the point of view of deciding which PI project has the highest PoS, a function of S_c to an estimated performance gain would be desirable.

$$P^* = f(S_C) \tag{1}$$

where P^* = Actual performance gain, continuous 0-1 scale

S_C = Process capability score, continuous 0-100 scale

The $P^* = f(S_C)$ model computes the quantitative levels of performance to organisational capability. However, the performance levels may differ between improvement types and organisations attempting to implement these improvement types to obtain performance gain. Hence, a special $P^* = f(S_C)$ model needs to be computed from some historical data making it inadequate as a feedback signal to many operational processes from which performance gain is required.

To examine the rationale behind the need for specific P^* models, the performance prediction model is schematically represented as a direct mapping of capabilities as shown in Figure 1.

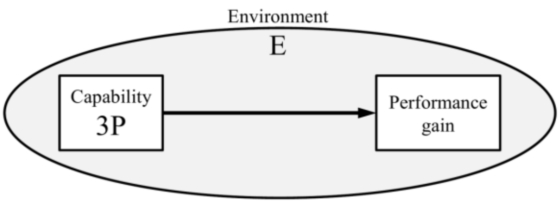

Fig. 1. Direct mapping of capabilities to performance gain

The model exists within a manufacturing system environment subject to external and internal noise and unintended variation. number of projects in progress, level of customer demand and production, availability of key personnel, time available for management to focus on improvement, availability of machines and people to perform experiments and process improvement prototyping, finance availability, key personnel on leave, and so on.

To separate the effect of the environment, the concept of performance effectiveness k_P is introduced as a measure of the amount of effort that can be realised from the capabilities of a company to implement a PI project as shown in Figure 2.

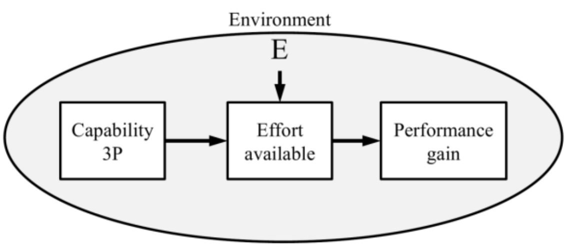

Fig. 2. Performance prediction model with environmental factors separately incorporated

Due to the uncertainty in the environmental factors, the performance effectiveness due to the capability level of a company will exhibit a probabilistic regression relation represented by Equation (2) and graphically in Figure 3.

$$k_p = g(S_C) \qquad (2)$$

where k_P = Performance effectiveness, continuous 0-1 scale

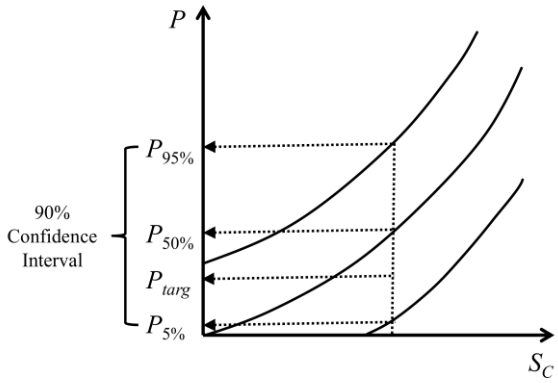

Fig. 3. The determination of capability score to performance effectiveness

Having defined the performance effectiveness function, we can then develop a method to understand the effect of uncertainty factors to performance at different levels of effort.

4 PERFORMANCE AND EFFECTIVENESS

Intuitively it is reasonable to expect that by putting in certain level of effort, the organisation can achieve a theoretical maximum performance if there are no external influential factors. This is the theoretical maximum defined at that level of effort. However, it is also possible that after putting in the determined level of effort, there is no improvement effect at all. A relation between performance effectiveness and performance itself as shown in Equation (3):

$$P^* = h(k_p) \qquad (3)$$

With the introduction of the concept of performance effectiveness k_p, the performance outcome of a PI project can be estimated from Equation (4).

$$P^* = h(g(S_c)) \qquad (4)$$

The actual performance gain P can then be computed by converting P^* with actual measurable units. The overall aim of the PI risk assessment method is to predict the level of performance gain P

to be achieved in probabilistic terms on a ratio scale based on an estimate of the S_C.

The design of a process can form the upper limit on the level of achievable performance (Kohlbacher & Gruenwald [24]). Hence productivity analysis on a process or system should aim at estimating the theoretically maximum performance that can be achieved from existing and projected capabilities and resources. The process design may determine the maximum theoretical performance level P_{th}. Assuming P_{th} is estimated adequately this performance level is only attainable if the organisational capability to execute and implement process improvement is close to perfect. The process improvement project would need to be 100 percent successful to achieve P_{th}.

The current performance level is designated P_0 or performance at time t_0. Minimum effort occurs when no PI actions are taken and as a result the status quo performance level at P_0 is maintained. Assuming the aim of a process improvement project is to improve performance then an upward movement in performance is required somewhere between P_0 and P_{th}. However, performance outcomes can be anywhere in between these two extremes. The question is how to determine the performance effectiveness when any given performance outcome is anticipated.

The opinions are solicited using the Analytic Hierarchy Process (AHP) developed by Saaty [25] to establish consistency of human judgement through a pairwise comparison process. Since its introduction, many researchers have enhanced the original AHP method particularly on the minimisation of uncertainty (Ocampo and Clark, [26]). The following method is adapted from these decision making processes of AHP but is modified to compute the relative level of effort required to achieve particular performance. The method compares the intensity of effort to move to defined discrete levels of performance P_i from discrete levels of performance P_j. The method uses the results of a productivity analysis produced to investigate a process improvement problem or initiative. The output from a productivity analysis is typically a list or set of actions or performance outcomes the organisation needs to address or implement to achieve the desired level of performance.

To arrive at the $k_P = f(P)$ function the method assumes a) the current performance level P_0 is known from measurement or estimation, and b) the maximum theoretical level of performance P_{th} has been estimated as a result of for example a productivity analysis.

To determine relationship between performance effectiveness factor and performance level, the AHP is applied to consolidate the vector of priority (VP) over the range of P_0 to P_n.

To illustrate this computational process, Table 1 is formed with a theoretical performance scale of 5 levels, i.e. $n = 5$. Saaty recommended $n \leq 7$ to allow effective correction for excessive inconsistencies the judgements obtained.

Table 1. Pairwise comparison judgement matrix – Intensity of effort

Intensity of Effort		P_j						VP_i
		P_5	P_4	P_3	P_2	P_1	P_0	
P_i	P_5	1	θ_{54}	θ_{53}	θ_{52}	θ_{51}	θ_{50}	VP_5
	P_4	$1/\theta_{54}$	1	θ_{43}	θ_{42}	θ_{41}	θ_{40}	VP_4
	P_3	$1/\theta_{53}$	$1/\theta_{43}$	1	θ_{32}	θ_{31}	θ_{30}	VP_3
	P_2	$1/\theta_{52}$	$1/\theta_{42}$	$1/\theta_{32}$	1	θ_{21}	θ_{20}	VP_2
	P_1	$1/\theta_{51}$	$1/\theta_{41}$	$1/\theta_{31}$	$1/\theta_{21}$	1	θ_{10}	VP_1
	P_0	$1/\theta_{50}$	$1/\theta_{40}$	$1/\theta_{30}$	$1/\theta_{20}$	$1/\theta_{10}$	1	VP_0

The pairwise comparison judgements θ_{ij} in Table 1 use the 1 to 9 intensity of effort scale from Table 2.

Table 2. Degree of required effort scale

Intensity of Effort	Definition
1	None
2	*Compromise between levels 1 and 3*
3	Small
4	*Compromise between levels 3 and 5*
5	Moderate
6	*Compromise between levels 5 and 7*
7	Large
8	*Compromise between levels 7 and 9*
9	Intensive

Table 3. Performance effectiveness function data table

i	P_i	VP_i	P_i^*	k_{Pi}
0	P_0	VP_0	P_0^*	k_{P0}
1	P_1	VP_1	P_1^*	k_{P1}
2	P_2	VP_2	P_2^*	k_{P2}
3	P_3	VP_3	P_3^*	k_{P3}
4	P_4	VP_4	P_4^*	k_{P4}
5	P_5	VP_5	P_5^*	k_{P5}
th	P_{th}	…	1	1

The performance effectiveness factor k_{Pi} is then obtained over the range 0 to 1 from Equation (5) where n is the total number of performance outcomes and θ_{n0} from Table 1 is the judgement of intensity of effort to move from the current performance level P_0 to the performance level P_n.

$$k_{Pi} = \left(\frac{\theta_{n0} - 1}{8}\right)\left(\frac{VP_i - VP_0}{VP_n - VP_0}\right) \quad i = 0,1,2,....,n \tag{5}$$

Finally, the relative performance P_i^* over the range 0 to 1 is calculated from Equation (6).

$$P_i^* = \frac{P_i - P_0}{P_n - P_0} \quad i = 0,1,2,....,n \tag{6}$$

We illustrate the methodology using a case example.

5 APPLICATION TO A REAL INDUSTRY CASE

5.1 Background

The case study is based on a process improvement conducted at an SME sized manufacturing organisation located in Australia and part of a company operating globally. The manufacturing company produces several main product families on a made-to-order basis including paint mixed and packaged to order. Customers are a mixture of local and overseas with a customer demand level exhibiting extreme variability.

Company management have noted an issue with inventory accuracy of raw materials and finished goods produced from the paint production section. This inventory data inaccuracy is responsible for a number of problems. The highest rated issues are the inability to fulfil orders and the detrimental effect on confidence in the business from a customer perspective. The ability to service customer needs is suffering and this is causing stress in customer support personnel. Other internal issues include the need to report to upper management manufacturing variances including stock written off as it has exceeded it shelf life. The inability to find stock in a timely manner wastes personnel time and reduces paint manufacturing capacity. The necessity and additional cost to air-freight in goods that were believed to be in stock but could not be found is expensive and wasteful. Local management have good reason to support process improvements that have the effect of inventory data accuracy.

Management have specified a performance target of P_{targ} = 90 percent inventory accuracy due to the belief achieving this level of inventory accuracy will reduce the aforementioned problems to an acceptable level. A problem is currently the inventory accuracy is not measured in any consistent fashion. As a result a snapshot was performed of the types and frequency of stock errors between the data in the work planning system and actual stock on the shelves. Analysis of this data indicated the current inventory accuracy is in the order of P_0 = 35 percent. The theoretical maximum inventory accuracy P_{th} equals 100 percent. An analysis of the problem recommended a number of changes. The question to be answered: What is the probability of success of meeting the 90 percent target if the recommended changes are implemented?

Table 4. Proposed improvement actions to close the performance gap

No	Required Improvement Actions
A	*Layout changes*
A1	The packing area is removed from the production area.
A2	Local storage in the immediate vicinity of the paint production area is expanded to include all consumables and raw materials moving in to the area and finished goods moving out of the area.
B	*Personnel responsibility changes*
B1	Responsibility for packing of finished goods is transferred to dispatch personnel from production operators.
B2	Responsibility for transport of all materials to and from the warehouse area is transferred from production operators to warehouse and/or dispatch personnel.
B3	Responsibility for providing accurate and timely status information on the state of raw materials currently in the paint production machine tanks is to be formalised. Reporting frequency and required accuracy to be specified by management.
B4	A function/person in the organisation must be designated as responsible for the timely entry to the material planning system of the current state of raw materials in the paint production machine tanks.
C	*Process changes*
C1	Production operators are prohibited from access to the warehouse area except under special circumstances (defined by management).
C2	Once raw materials are transported from the warehouse to local production storage any unused portion is not returned to the warehouse.
C3	Management put in place routines to replenish raw materials and consumables to the production local storage.

5.2 Productivity Analysis Findings

A productivity analysis was performed using a simplified version of the systematic handling analysis (SHA) by Müther and Hagan äs [27] involving study of the materials flows though the production and warehouse areas. Source data was a combination of operational data provided by management, observation, and informal interview with operators and staff. The key finding is that picking and transporting of goods to and from the warehouse is current performed by production operators. This use of non-specialists operating in the warehouse has the effect that standard warehouse operating procedures to control and track materials and their locations in the materials planning system are not formalised and decisions are made on the floor to solve immediate production problems with insufficient regard for the waste and other issues caused as a consequence. A side effect of this mode of operation is the waste time spent by production operators in transport activities instead of focus on production.

The proposed outcomes to be implemented by the organisation are presented in Table 4. These outcomes are grouped into three main categories of A) layout changes, B) Personnel responsibility changes, and C) process changes. The aim is to reduce the transport work performed by paint production operators to assist in a) increasing paint production capacity by reducing waste transport movement, and b) improving inventory accuracy in the warehouse and production areas.

The transport work reduction is transferred to other functions such as warehouse and dispatch staff not being a production bottleneck. The current transport work for production operators is estimated at 12,300 kg-meters/day. This transport workload for production operators is reduced under the proposal to 4,000 kg-m/day, equivalent to a 67 percent reduction.

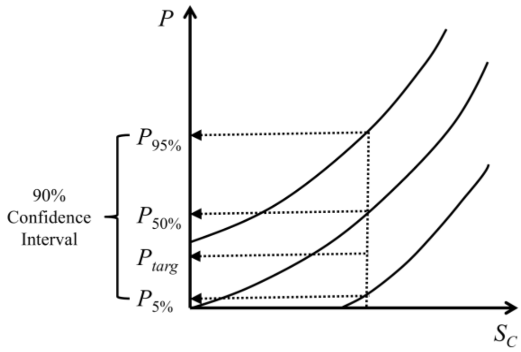

Fig. 4. Performance effectiveness function plotted against capability

For the case study the estimated *Sc* values range for the project corresponded to a 90% confidence interval of 0.37 to 0.71 with median 0.54 based on the rating by several management employees of capability factors based on the effort applied by the company on each capability. The 90% prediction interval and median on inventory accuracy performance can be estimated from the performance effectiveness function in Figure 4.

Table 5. Pairwise comparison judgement matrix – Intensity of effort

Intensity of Effort		P_j						VP_i
		100	95	85	70	50	35	
P_i	100	1	2	3	5	6	8	0.385
	95	0.500	1	2	4	7	7	0.273
	85	0.333	0.500	1	3	5	6	0.181
	70	0.200	0.250	0.333	1	2	3	0.079
	50	0.167	0.143	0.200	0.500	1	2	0.049
	35	0.125	0.143	0.167	0.333	0.500	1	0.033

5.3 Estimate of the Performance Effectiveness Function

Boundary values for performance are P_0 = 35 and P_{th} = P_5 = 100. Intermediate performance values chosen for the pairwise comparisons are P_1 = 50, P_2 = 70, P_3 = 85, and P_4 = 95. Calculated P_i^* and k_{Pi} points are obtained from Equations (2) and (3). The estimated performance effectiveness function is shown in Figure 5.

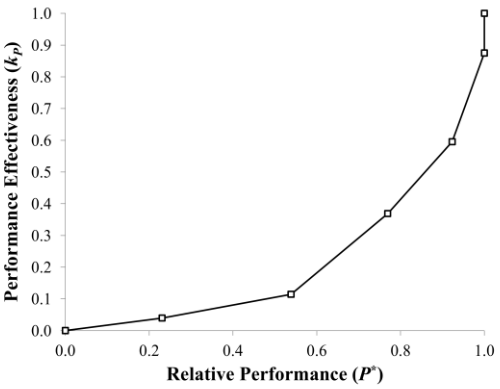

Fig. 5. Performance effectiveness function

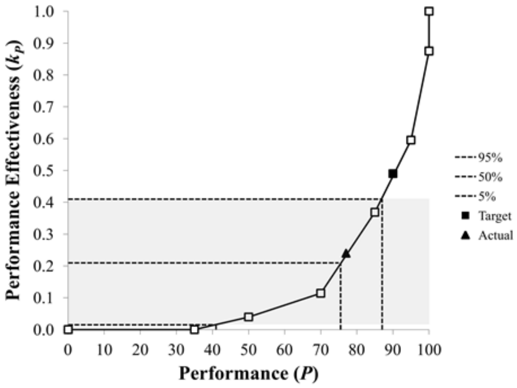

Fig. 6. Performance median and prediction interval after improvement

Table 6. Performance effectiveness function data table

i	P_i	VP_i	P_i^*	k_{Pi}
0	35	0.033	0.00	0.00
1	50	0.049	0.23	0.04
2	70	0.079	0.54	0.11
3	85	0.181	0.77	0.37
4	95	0.273	0.92	0.60
5	100	0.385	1.00	0.88
th	100	…	1	1

5.4 Estimate of Median and Prediction Intervals for P

The k_P median of 0.21 corresponds to a median inventory accuracy P of 76 percent with a 90 percent prediction interval of 41 to 87 percent. The probability of the PI project achieving the desired 90 percent inventory accuracy target after implementing the improvement actions is less than 5 percent. This indicates if management leave the result to chance without special focus the probability of meeting the target is low. Particular focus is required by the organisation to achieve the performance target.

A repeat measurement of inventory accuracy after implementation of the actions achieved a result of P = 77 percent. This result is inside the 90 percent prediction interval on the high side. This result might he disappointing to management however it is inside the expected range expected from an organisation with its PI capability. There is some evidence one or more actions have not been successfully implemented. A review of the situation indicated instances where production personnel reverted to previous work processes with consequent introduction of inaccuracies in inventory.

6 DISCUSSION

The aim of the PI risk assessment method is outlined in Figure 7. An estimate of the organisation's capability to execute and obtain benefit from PI projects is determined by an organisational as input to the PI project. Different projects will exhibit different performance patterns. Project D is a low hanging fruit project in which a small increase in effort can produce significant improvements in performance. Project A is a project that requires extensive planning and preparation. Considerable effort is spent initially but the measurable progress or performance is not observed until a large effort is put into the project. Projects B and C are projects exhibiting patterns between Projects A and D.

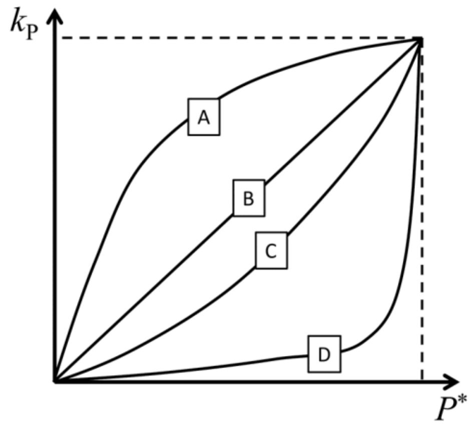

Fig. 7. Varying effort kP to achieve a relative performance gain P1* in diverse PI projects

Input from a broad sample of company employees within the company are used to estimate the probability distribution of k_P for a process improvement project. This information allows calculation of the median and confidence interval on k_P for example 90% confidence. An estimated performance distribution according to the measured S_c of the company can then be measured through k_p. A decision maker uses this information to set a performance gain target with an acceptable probability of success and conversely an acceptable probability of failure.

The method provides a means of estimating the difficulty of projects. It can be used in circumstances where the improvement actions have not yet been specified as is therefore suitable in preliminary design stages of improvement projects. A reiteration of the method can be made when more advanced details are required of the required actions to implement the improvement typically after a productivity analysis of the problem or system.

7 CONCLUSION

Organisations engaged in process improvement initiatives want a return on their investment in the form of increased performance in one or more areas. It is generally acknowledged in the literature the probability of not meeting performance target goals from PI is unacceptably high. The application of risk management to better understand risks contributing to failure, better understanding that initial success does not guarantee longer term performance goal attainment, and having more realistic goal setting in accordance with PI capability would improve the probability of success. The availability and application of a risk assessment model that provides insights into expected and range of performance results is a critical tool in this regard.

An overall risk assessment method is presented with focus on one component of that method mapping performance effectiveness to performance gain in relative or actual measurement units. The method provides for estimating the performance effectiveness versus performance function applicable for a particular PI project.

Use of the risk assessment method would provide organisations with insights on the level of risk they are facing dependent on their current PI capability and reinforce the need for constant focus if the target gains are to be achieved within an acceptable probability.

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