IMPACT OF DevOps SKILLS ON PROJECT MANAGEMENT OUTCOME – AN EMPIRICAL STUDY

[1]Prof. Dr. Sachin S. Vernekar and [2]Sanjay Kumar Dhar

[1]Dean Faculty of Management Studies, Bharati Vidyapeeth Deemed to be University & Director, Institute of Management & Entrepreneurship Development (IMED), Pune

[2]Research Scholar, Institute of Management & Entrepreneurship Development (IMED), Pune

Abstract: This paper deals with the impact of DevOps skills on project management result in IT Organizations. Project Management practices determine the success of the project. DevOps uses lean principles and brings development and operation together throughout the concept to cash cycle. The study aims to understand the impact of DevOps Skills on Project Management outcome . It studies whether Project management skills has positive impacts on results and whether impact of Project management on results can be improved with inclusion of DevOps skills. For this purpose, data was collected through the questionnaire as a data collection tool from IT Managers and DevOps Engineers. Data was analyzed with SPSS software. Path analysis for validation of the path model. Cronbach Alpha is used to confirm reliability of instruments. The present paper proposes a model to reveals a direct relationship between project management skills and results and indirect relationship between project management skills and results. Finally suggestion for applying DevOps practices in project management are suggested.

Keywords- DevOps, DevOps Impact, Project Management, DevOps Skills.

1. INTRODUCTION

Project management is the initiating planning, organizing and managing the resource efforts   to accomplish a successful project. Project management includes creating a project plan, which involves defining and agreeing the project key goals and plan how project goals will be achieved, identifying tasks and quantifying the resources needed, and determining cost budgets and timelines for project completion. It also includes managing the implementation of the project plan, along with operating governance to ensure that there is correct information on 'performance' relative to the plan, and the mechanisms to implement corrective actions wherever necessary.   Today companies are undergoing digital transformation This means companies needs to adapt these changes and get aligned to Agile and DevOps practices.

Agile is one of the most recognizable project management methodologies in digital transformation age and is best suited to projects that are iterative and incremental. It's a kind of project management process where requirement and solutions evolve through the collaborative effort of self-organizing and cross-functional teams and their customers. Agile & DevOps go complimentary to each other and in recent years have become critical part of business operation. The DevOps during the life cycle of the software helps in reducing number of steps to brink software to the market. The focus is on faster reach to the marked along with Swift User feedback.

DevOps provides significant ROI by increasing the speed of releasing new features to market – the lead time from concept to customer would be significantly shortened. DevOps increases the quality of products there by reducing the costs of rework, outages, increase customer satisfaction, improves utilization of infrastructure as infrastructure is built on demand, it reduces the development and operations cost with high degree of automation in tasks currently done manually.

DevOps boosts Organizations agility and is all about making the business successful by delivering MVP (Minimal Viable Product) to the customer faster and in a reliable way. DevOps fundamentally changes How IT managers approach the project by moving away from traditional monolithic multi months and multi years project initiatives and adapt to greater speed and agility in delivering MVP's.

2. DEVOPS SKILLS

DevOps requires development, testing, build, release management and operation teams to follow best practices in their areas and technology. The project teams as required need to be introduced to system thinking, Continuous Integration & Build, Continuous Delivery, Continuous Monitoring, Continuous Deployment, DevOps Consulting Skills, DevOps Operating Model Awareness, Infrastructure Provisioning Skills, DevOps Enabled agile Practices, Ample Feedback Loops, Collaborative Development, Lean & Agile Development, Create Real Time Visibility, test automation tools, application release automation tools, application performance monitoring tools, Platform as service (PaaS) tools, Infrastructure as a service(IaaS) tools and Software as a service (SAAS) tools.

3. DEVOPS KEY TERMS

DevOps provides a blend of processes and philosophies that drive a cultural shift to a company by promoting collaboration between build and operations team. DevOps aims at establishing a DevOps mindset and environment where building, testing, and releasing software, can happen fast, frequently, and more reliably. DevOps practices integrates the traditionally siloed departments of development and IT operations.

Continuous delivery is an approach to automating the whole software development process from design through deployment. DevOps teams make changes to the software in sprints and via Continuous Integration and Continuous deployment pipeline, Continuous delivery can happen any time as per business need. The continuous delivery pipeline breaks down continuous delivery into stages like Development, QA, UAT & Prod, integrated tools constantly communicate with one another across the pipeline.

Continuous build, As soon as Developer commits the change , a job is triggered in the continuous integration tool and that enabled continuous build. This build then goes through scanning via code quality tools and once the build passed the required quality threshold, the build is ready for testing.

Continuous testing various styles of testing, e.g. static analysis, dynamic testing, regression testing and security testing, at different stages of the delivery pipeline. Testing incremental changes to the software can help DevOps teams identify and resolve defects sooner.

Continuous deployment is when software changes made by developers are automatically deployed into the operational environment. it's an integral a part of continuous delivery because it addresses the handoff between development and operations.

Configuration management are integral parts of the DevOps. Configuration management is about automation, monitoring, management and maintenance of system-wide configurations that occur across networks, servers, application, storage, and other managed services. It enables DevOps team to provision servers on demand and apply vulnerability patches across all the servers with ease with the help of configuration management tools and designed DevOps enabled configuration management process.

Continuous Monitoring focus on continuous monitoring and promotes shift left of defects. With the help of monitoring tools, it monitors application, infrastructure & user experience. the tools captures evets which are not within the acceptable threshold and automatically raised the alarm by sending feedback data for ensuring proper processing of transactions and identifying the underlying infrastructure of an application.

Agile When combined with DevOps automation, Agile provides a compelling integrated solution for delivery. Agile introduces new roles and behaviors (e.g. scrum master and stand-up meetings) that break down traditional siloes and foster collaboration, iteration and self-directing teams. Agile emphasizes a

minimum viable product (MVP) delivering the agreed product sooner instead of later because the team will iterate.

Lean refers to a collection of principles geared toward process improvement that DevOps teams can leverage to boost the efficiency and speed of the continuous delivery pipeline. Lean principles can help DevOps teams identify and take away bottlenecks and non-productive tasks within the delivery process.

4. LITERATURE REVIEW

PMI PMBOK, (2008), Project management body of knowledge is a recognized standard for project management profession. The book introduces key concepts in project management field. PMBOK provides a common vocabulary within the project management profession for discussing and applying in project management.

Obeidat, Mohammad Abdul Qadir, (2016), shows that Project Management Information's systems (PMIS) has become strategic resource for project managers in managing project optimally. The study reveals a positive correlation between use of PMIS and project performance during project execution.

Christopher Cullen, (2011), The study highlights project management effectiveness tool that measures the effectiveness of software project management. The focus is to gain effectiveness in project management practices by implementing quantitative measurements.

Gene Kim, Kevin Behr, George Spafford, (2013), The Phoenix Project's subtitle is "A Novel About IT, DevOps, and Helping Your Business Win." . This book is a manual for helping IT managers change the way employees think about the way they plan, schedule and complete work. Practical approaches to creating change, like Kanban and continuous delivery and are illustrated through relatable use cases.

Sriram Narayan (2016), This book explains management of Agile based development. The book provides insight for IT manager to move from Systems of records and adapt in system of engagement and required organizational changes to deliver in agile way. Conclusion is having Agile IT Organization design in place and model related practices and promote collaboration and integrations among process, methods and tools.

The Open Group IT4IT Forum Agile Work Group (2016), This document describes the application of the IT4IT Reference Architecture to the area of Agile Development using techniques such as DevOps and Kanban. This document explains how to apply the IT4IT Reference Architecture, an Open Group Standard, to various different scenarios related to managing the business of IT.

Rayome, Alison DeNisco (2017), The study highlight challenges in DevOps implementation and address how to overcome them. Some of the key challenges highlighted in the study are related   to company culture, test automation, and legacy infrastructure.

Duma, Yevhenx (2018), the study reveals 10 DevOps skills required to work in DevOps , Some of key skills that has been given focus are strong communication and collaboration skills, Coding , automatic testing & software Security skills.

Choudhuri, Niladri (2019) The Upskilling 2020 report from DevOps Institute highlights process skills and knowledge as main important skills for DevOps. Governance, Risk and Compliance (GRC) skills have gained focus recently. The study reports Collaboration and cooperation as one of the top skills required in DevOps.

Brownlee Dana, (2019) , The study offers about the project management trends on the horizon and focus on the areas where project managers needs to have broader skills and technically aligned with trending technologies.

Donnelly, Caroline (2017), This article explains how to build a developer and operations collaboration (DevOps) culture. Tips mentioned include the head-on address to legacy technology problems and technical debt, the avoiding of being stuck in fire fighting cycle, and the need to stop the break-fix-style

cycle. Conclusion is to promote collaboration among development and operations team and promote DevOps mindset.

Sanjeev Sharma, Bernie Coyne, (2015), This book "DevOps for Dummies" explains a business-centric approach to DevOps. Objective is to implement DevOps essential for all organizations that must be agile and lean enough to respond rapidly to changes such as customer demands, market conditions, competitive pressures, or regulatory requirements.

Muslihat Dinnie, (2018), The scope of this study was to understand popular Project management methodologies and get insights about project characteristics associated with each type of project methodology.

Cohan , Esther, (2019). The study gives overview about different types of project management methodologies.

S.W. Ambler, (2011), The journal focused on "Disciplined Agile Delivery." Elements such as release and deployment should be integral parts of agile vision and daily activities. Conclusion is to focus on Disciplined agile delivery, collaborative DevOps and have DevOps enabled agile delivery model.

5. OBJECTIVE

- To understand the relation between project management skills and DevOps Skills

- To understand the impact of DevOps Skills and Project Management skills on project outcome.

- To understand the impact of DevOps Skills on Project Management outcome

- To proposes a model to reveals a direct relationship between project management skills and results and indirect relationship between project management skills and results.

6. HYPOTHESIS

Hypotheses (H0): Project Management skills will not positively impact results.

Hypotheses (H1): Project Management skills will positively impact results.

Hypotheses (H0): DevOps Skills are not positive predictor of results.

Hypotheses (H2): DevOps Skills are positive predictor of results.

Hypotheses (H0): Project Management skills are not positive predictor of results.

Hypotheses (H3): Project Management skills are positive predictor of results.

Hypotheses (H0): DevOps Skills will not mediate relationship between project management skills and results.

Hypotheses (H4): DevOps Skills will mediate relationship between project management skills and results.

7. RESEARCH METHODOLOGY

Type of research was descriptive and nature of research was quantitative. Structured

questionnaire with 5-point scale (Rank 1 is equal to More Important Challenge and Rank 5 is equal to least important challenges). was used for data collection. They were offered 12 common challenges in DevOps.

Non-probability Quota sampling technique was used to select the sample for collecting primary data. The targeted segment for this study was Managers DevOps projects and DevOps engineers working on DevOps implementation.

The study included 117 respondents for each IT Managers and DevOps engineers and were requested to provide information. however, 13 questionnaires were rejected due to incomplete data therefore 104 is the

sample size that was taken into consideration. The type of analysis was statistical. Path Analysis statistical technique was used and data was analyzed with SPSS ver. 24 software.

8. DETERMINATION OF SAMPLE SIZE

Sample size was determined using sample size determination by mean method.

Variables in study were measured using a 5-point measurement scale, hence the mean method was adopted.

Formula

$$N = \frac{z^2 * s^2}{e^2}$$

Where, 'z' is the standard score associated with confidence level (90% in the current case). Hence standard scores equals to 1.645 (borrowed from normal table)

'S' is the variability in the data set, computed as a ratio of range / 6. Range is equal to 5-1 = 4 (the difference between minimum and maximum value in the 5point scale). 6 refers to ±3 standard deviation values on the X axis of the standard normal curve, which takes in all the data set in study.

Hence S = 4/6 = 0.66

E is the tolerable error = 10% (in the current study).

Sample size n $= \frac{1.645^2 * 0.66^2}{0.1^2} = 117$

117 respondents were requested to provide information; however, 13 questionnaires were rejected due to incomplete data therefore 104 is the sample size that was taken into consideration for teaching.
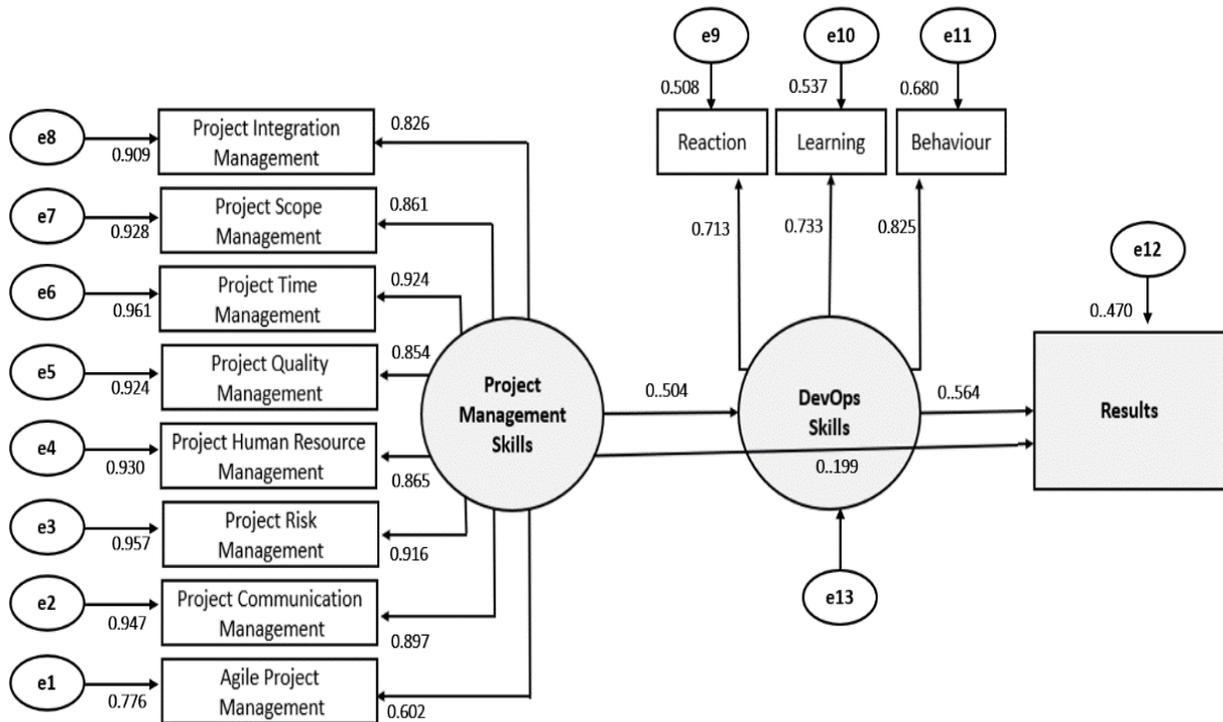
Final sample size = 104

9. HYPOTHETICAL MODEL

The purpose of this research paper is to create a new knowledge through a systematic investigation process.

The researcher has attempted to contribute to body of knowledge by promising and validating the following Model.

Fig 1 DevOps Skills leads to Better Project Results

The above hypothetical model reveals a direct relationship between project management skills and results and indirect relationship between project management skills and results.

Project Management skills is a latent construct measured using 8 measured indicators (Project Integration Management, Project Scope Management, Project Time Management, Project Quality Management, Project Human Resource Management, Project Risk Management, Project Communication Management and Agile Project Management)

DevOps Skills are measured using 3 measured indicators (Reaction, Learning and Behavior)

Results are measured in 5 point scale and respondents were measured to 5 point scale and respondents were measure to conduct Project management skills.

Results are the outputs and outcome from the project.

RESEARCH QUESTIONS
Whether Project management skills has positive impacts on results ?

Whether impact of Project management on results can be improved with inclusion of DevOps skills ?

HYPOTHESES
(H1): Project Management skills will positively impact results

(H2): DevOps Skills are positive predictor of results.

(H3): Project Management skills are positive predictor of results.

(H4): DevOps Skills will mediate relationship between project management skills and results.

PATH ANALYSIS
Path Analysis is minor version of structural equation modeling. Path analysis is a multi-variant analysis technique used to study impact of several variables simultaneously. Path analysis was developed by

geneticist Sewall Wright in the year 1920s to analyze the effects of hypothesized models in phylogenetic studies.

Path analysis could be a statistical technique that permits users to analyze patterns of effect within a system of variables. it's one in all several sorts of the final linear model that examine the impact of a group of predictor variables on multiple dependent variables. Path analysis is analogous to multiple regression and in this, the effect of multiple predictors on a criterion variable is assessed.

In a path analysis model from the regression matrix, two or more casual models are analyzed and compared. The path trail of the model is shown by a square and an arrow, which shows the causation. Regression weight relies by the model. Then the goodness of fit statistic is calculated so as to determine the fitting of the model.

The path model has two types of effects. The first effect is the direct effect, and the second effect is the indirect effect. When the exogenic variable has an arrow directed towards the dependent variable, then it is said to be the direct effect. When an exogenic variable has an effect on the dependent variable, through the other exogenic variable, then it is said to be an indirect effect. To see the total effect of the exogenic variable, we have to add the direct and indirect effect and analyze the effect.

RELIABILITY & VALIDITY
Reliability is the ability of the scale to produce consistent result. It is the extent to which items of the construct corelate with each other. It is a measure of internal consistency.

For a measuring scale Cronbach's alpha (α) is used to study reliability of the instrument. Cronbach's alpha (α) is one of the most popular technique to study reliability.

Cronbach's alpha (α) will range between 0 to 1. Cronbach's alpha (α) value of 0.7 and above indicates reliability.

Validity is the ability of the scale to produce accurate results. It is the extent to which the scale measure what it is supposed to measure. For the current model, Avg variance extracted is used to confirm validity.

Avg value extracted is an average of factor loading square for items of the construct. Average extracted value will also range between 0 and 1 .

Average value extracted of .5 and above indicate validity.

Construct / Variable	No of Items	Alpha	AVE
Project Management Skills (F1)	8	0.977	0.843
DevOps Skills (F2)	3	0.800	.575
Results	-		

Since this is single item scaled variable. Test Retest method was used to study reliability and construct variability ratio is used to study validity

Correlation		RESULT (Positive outcome of training)	Test Retest
RESULT (Positive outcome of training)	Pearson Correlation	1	.984
	Sig. (2-tailed)		0
	N	104	104
Test Retest	Pearson Correlation	.984	1
	Sig. (2-tailed)	0	
	N	104	104

Reliability - Test Retest Method

Since Results is a single item scaled variable Test-Retest Method of reliability is used to check whether the scale measuring results can provide consistent results. Test Retest is simple and straightforward forward method of confirming reliability. In this method the same scale is administered on to the same respondents on two different occasions. the two set of data are then correlated to compute correlations coefficient. Coefficient closer to 1 indicates reliability. For RESULTS the correlation coefficient is 0.984, hence reliability is supported

Outcome variable		Predictor	Beta value	P value
F2	<---	F1	0.504***	<0.001
O4	<---	F2	0.564***	<0.001
O4	<---	F1	0.199***	<0.001

Hypothetical Model test results

The above table reveals the following findings

(H1): Project Management skills are positive predictor of DevOps skills.

(Beta Value = 0.504, p < 0.001)

The beta value indicates that if project management skills is increased by 1 unit. DevOps Skills will go up by 0.504

(H2): DevOps Skills are positive predictor of results.

(Beta Value = 0.564, p < 0.001)

The beta value indicates that if DevOps skills is increased by 1 unit. Result will go up by 0.564.

(H3): Project Management skills are positive predictor of results.

(Beta Value = 0.199, p < 0.001)

The beta value indicates that if project management skills is increased by 1 unit. Result will go up by 0.199

Accessing the Mediation effect.

path	direct effect	indirect effect	result
Project Management Skills -----> results	B = 0.199, p = 0.096	B = 0.584, p = 0.000(<0.001)	full mediation

H4): DevOps Skills will mediate relationship between project management skills and results.

From the above table it can be seen

For Direct Effect

B = 0.199, p = 0.096 (In Significant)

For Indirect Effect

B = 0.584, p = 0.000(<0.001) (Highly Significant)

Since the Indirect effect is stronger the Direct effect. (Full Mediation exists between project management skills and result)

Hence it is concluded that DevOps skills mediates relation between project management skills and result.

Bootstrapping Amos 21 is used to study the mediation effect.

Assessing the Model FIT

Five fit indices have been used to study fit between hypothetical model and sample data. (CMIN/DF, CFI, GFI, PNFI, RMR)

Fit indices	Observed	Criteria for acceptable fit	Result
CMIN/DF (Minimum discrepancy as indexed chi-square)	3.008	Less than 5	Acceptable fit
CFI (Comparative fit index)	0.930	More than 0.9 for good fit, between 0.9 to 0.8 for borderline fit	Acceptable fit
GFI (Goodness of fit index)	0.831	More than 0.9	Acceptable fit
PNFI (Parsimonious Normal fit)	0.709	More than 0.5	Acceptable fit
RMR (Root Mean Residual)	0.037	Less than 0.08 for adequate fit, between 0.08 and less than 0.1 for borderline fit	Acceptable fit

The above table reveals that all the fit indices show a fit between hypothetical model and sample data except for GFI which has a marginal miss . Hence the Model is statistically acceptable model.

10. SUGGESTIONS

Suggestion for applying DevOps practices in project management for better project outcome are as follows

- With technology handling many of the project management activities. It is advised IT Project Managers should be trained on Coaching Skills and apply those skills in changing Cultural Mindset towards DevOps.

- With Technology changing very fast these days. DevOps Team need to keep up with the pace by learning new things. With Challenging requirements, it is essential for IT managers to focus on their emotional intelligence. IT managers should develop strong social skills and develop ability to show empathy so that they can motivate other team members and led to better project outcome.

- IT project managers should develop their technology quotient. this will enable IT Project Managers to make correct decisions in choosing the right technology which otherwise can have disastrous effects on projects outcome and costing.

- IT Managers should Develop skills in Agile project management and apply agile methodologies in managing DevOps deliveries. They should be trained on tools used for Agile Project Management so that can use that tool effectively from Agile Project Management perspective.

- IT Managers should be aware about DevOps best practices and DevOps trainings should be arranged for them before they are onboarded to DevOps projects.

- IT Managers should incorporate data analysis in the project management process. IT Managers should stay up to date on new tools and new cloud service offering. Technologies like Artificial Intelligences should be implemented to generate   predictive analytics and real time project updates. Predictive analytics capabilities should be exploited for manage risks more proactively and effectively.

- IT Project Managers need to develop efficacy in Cloud. The Project managers needs acquire Cloud skills. They need not to be specialized in cloud computing service but should be to be aware about the value adds provided by these services so that right fit of services are procured to address the specific project needs. Project Managers should advocate developing cloud native portable containerized application to avoid Vendor locking

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