

# IMPACT OF INTRINSIC MOTIVATION ON RESEARCH OUTCOMES OF FACULTY IN ENGINEERING INSTITUTES IN BENGALURU – AN EMPIRICAL ANALYSIS

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## **Abstract:**

In modern educational institutions, the teaching staff have a wide variety of tasks to be carried out spanning areas of teaching, mentoring, and student engagement, training for self and for others, curriculum design and so on. However, proving one's acumen in research performance and productivity stands out as the most sorts after indicator of a faculty's job profile. This is especially true in case of engineering institutes as engineering and steering innovation in the society go hand in hand. While research productivity of faculty is influenced by several factors such as the leadership in institute, environment, research culture, facilities available for research to be carried out etc, the role of intrinsic motivation is often unnoticed and vouched for in academic literature. The present study thus tries to examine the impact of intrinsic motivation measured in terms of purpose, mastery and autonomy on research performance of teaching staff of engineering institutes. The study examined the perspectives of 381 faculty spanning verticals of four branches in engineering. The mix of several designations viz assistant professor, associate professor, professor and departmental heads were considered for data collection via questionnaire. Factor analysis and regression techniques were adopted to analyze the data further. The results reveal a significant influence of intrinsic motivation measures namely autonomy, mastery and purpose on research productivity and performance of faculty members.

**Keywords:** Research Productivity, Intrinsic Motivation, Engineering Institutes, Faculty Performance, Institutional Excellence.

## **INTRODUCTION**

Faculty Productivity has been the most discussed aspect of research related to teaching staff of various institutions as it eventually determines economic development (Bean, 1998; Tien 2008). The traditional measures of productivity spanning teaching effectiveness, the number of students effectively mentored, contributions to knowledge and design of curriculum and value addition have widely been studied for decades now and seem to continue to define the standards of faculty performance. However the most valuable currency of the current academic scenario is research. Research, quite often considered as a cornerstone of innovation and policy making is the fulcrum of any academic organization in the higher educational institutions space.

Focused research efforts by faculty members of colleges has been considered vital for it adds value, impacts new age discoveries, validates previously held assumptions and fosters excellence in all realms of the society (Flagg et al., 2011; Levitan and Ray, 1992; Long et al.,

1998). With this context, academic literature has over the years focused on understanding the antecedents and consequences of enhancing research productivity. While the consequences of good research are well known, what causes or influences impactful research in academic institutions needs to be deliberated. While the role of institutions in shaping a productive research culture has gained attention in the recent past, the influence an individual's intrinsic drive, urge and motivation still needs deliberate comprehension in academic literature. Building upon Pink's theory of motivation, the present research work therefore tries to explore the innate influence of internal motivation on research productivity of faculty in engineering institutes.

### **Theoretical Underpinnings**

Daniel Pink (2009) developed the Intrinsic theory of motivation encompassing three significant components namely – Purpose, Autonomy and Mastery. The theory based on Pink's experience and research in his corporate and advisory endeavours is an addition in the new age as regards the motivation construct for individuals and organizations alike to take benefit of. Purpose encompasses the broad needs of career goals, drive and factors relating to achievement. Mastery spans areas of skill acquisition, skill integration and skill application. Autonomy consists of research subjects, aims, partner selection and research execution. The present study thus seeks to explore the role of each of these three components of intrinsic motivation on research outcomes and productivity of faculty.

### **REVIEW OF LITERATURE**

Bland et al. (2005) found that motivation (as a dimension of individual Characteristics) significantly influence research productivity. But in contrast, Hedzaji and Behravan (2011) who used almost similar dimensions with Bland et al. (2005) revealed that there was no correlation between motivation and research productivity. Furthermore, Hedjazi and Behravan (2011) found that the dimension of individual characteristics which have the positive effect on research productivity were autonomy and commitment, work habit, and creativity. Then, different with Martinez, Floyd, and Erichsen (2011) highlighted several individual traits which are positively correlated to research productivity: persistence, discipline, work ethic, open-mindedness, and patience. A person's previous success at performing a task enhances his or her skill level and self-efficacy in that realm, increasing both the desirability of pursuing and the probability of competently repeating that behavior (Mael, 1991).

One elemental question that behavioral researchers have long-focussed on is the relative influence of the individual v. the situation or environment in determining individual behavior (e.g. Heller et al., 2004; Pervin, 1989). As a long-standing inquiry in organizational behavior, one view is that each person brings his/her own disposition, values, and cognitive bearing on situations; this view is sometimes referred to as a person- or trait-focussed approach. In contrast, another position in this literature assumes the primacy of situational conditions (e.g. task characteristics, pay systems, workplace design) in understanding and predicting the behavior of people in organizations (Bolman and Deal, 1992). For example, some argue that faculty members' motivation to produce research is based on the relative value they place on

the intrinsic and extrinsic rewards received from research (Chen et al., 2010).

Personality is regarded in the management literature as a logical proxy for an individual's level of motivation (Barrick et al., 2002; Gellatly, 1996). Various scholars have particularly embraced the Five-Factor Model of personality as a replicable and unifying taxonomy of personality (e.g. Digman, 1990; Goldberg, 1992; John, 1990). In particular, Barrick et al. (2002) argued conscientious individuals have higher intentions for achievement striving. Conscientious individuals are dependable, responsible, organized, ordered, and achievement-oriented (McCrae and Costa, 1989; McCrae and John, 1992), all of which appear relevant for academic research productivity.

Another "person" variable we anticipate affecting faculty research productivity is individual research values. A faculty member's personal research values should tap their motivational intentions to engage in and make time for research-oriented projects and tasks. Conversely, those who do not highly value research would be less likely to spend much time and effort engaging in research-related activities or conducting research. For example, in a study of Australian academic research productivity, Ramsden (1994) found that genuine intrinsic interest in one's discipline or field was a significant predictor of research output. Indeed, prior empirical research has found that academic researchers with high professional commitment and values demonstrate the highest research productivity (Jauch et al., 1978).

Faculty member's confidence in their research abilities was found related to faculty research productivity. Pabhapoteus (1996) model of faculty research productivity included research competence in one's research as an explanatory factor. Increased ability to do research was also correlated with increased research productivity according to the study conducted by Panthupa (1997). Adding on to this, it was held that being motivated about research was the most commonly reported enabler of research productivity, across all disciplines and career stages" (Snowball & Shackleton, 2018).

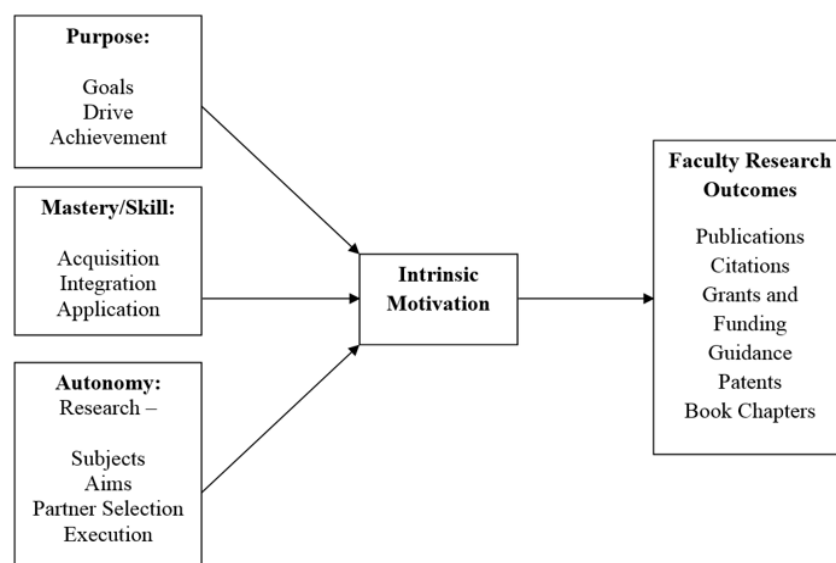
David McLoad (2014) presented that there are three important aspects of faculty engagement in research. These are attitudes, behaviors, and outcomes. The highest level of faculty engagement is when the "sense of involvement and pride" are turned into enthusiasm while owning something that can take pride in his achievement. Individual psychological characteristics such as research orientation or preference for research, motivation including extrinsic and intrinsic motivation, research confidence or self-efficacy, and desire for achievement and recognition, among others, are also important factors which impact upon academics' research engagement and productivity.

Numerous studies have investigated the relationship between these factors and research productivity and there seems to be a consensus that academics that are research-active and research-productive are those who are oriented towards research, extrinsically and intrinsically motivated to do research, and have a high level of research self-efficacy (Chen et al., 2006; Kwiek, 2016; Ramsden, 1994; Shin & Cummings, 2010).

Motivation, together with desire for recognition, is another crucial factor that has frequently been shown to influence academics' research engagement and productivity. Older studies like Bland et al. (2005) and Chen et al. (2006) confirmed the impact of motivation on research productivity. Findings of these studies are corroborated by more recent investigations which reported that motivation, especially intrinsic motivation, is a major enabling factor for academics' research engagement and productivity (Horodnic & Zaiț, 2015; Ryan, 2014; Snowball & Shackleton, 2018). Another individual psychological characteristic which has received great attention in the literature is research self-efficacy. According to Bandura (1986), self-efficacy refers to "people's judgements of their capabilities to organise and execute courses of action required attaining designated types of performances" (p. 391). Based on this definition, research self-efficacy refers to "one's confidence in being able to successfully complete various aspects of the research process" (Kahn & Scott 1997, p. 41). This individual characteristic has consistently been found to have a positive association with academics' research productivity (Eam, 2015; Pasupathy & Siwatu, 2014; Quimbo & Sulabo, 2014). For example, in a survey-correlation study of 377 faculty members from five state universities in the Philippines, Quimbo and Sulabo (2014) found that research self-efficacy is a significant determinant of research productivity.

**Gaps in Research:** From the extensive review of literature it is evident that while the role of motivation and individual needs have been explored in depth, the pertinent role of intrinsic motivation alone on research productivity has gained less attention. Moreover, while most research studies have focused on institutions in general, less work has been expended towards understanding the role of intrinsic motivation on research productivity of faculty of engineering institutes in specific. Thus the present study seeks to explore the larger influences of the three components of intrinsic motivation namely purpose, autonomy and mastery on faculty research productivity.

### Framework



## Research Objectives

1. To identify the most significant variables amongst intrinsic motivation components influencing faculty research productivity and outcomes.
2. To examine the role of purpose component of intrinsic motivation on faculty research outcomes.
3. To examine the role of mastery component of intrinsic motivation on faculty research outcomes.
4. To examine the role of autonomy component of intrinsic motivation on faculty research outcomes.

## METHODS

The present study is descriptive in nature as it examines the details pertaining to research outcomes of faculty and the factors behind it with an empirical lens. A stratified random sampling procedure is employed to select the samples (institutes) needed for the study which is explained as follows: At the first stage, engineering colleges in Karnataka are stratified based on ownership/funding (Government Colleges, Private Colleges, Aided Colleges and Deemed Universities). Then the total number of faculty in engineering institutes is determined – which happens to be 36862 faculty in a total of 194 colleges. Slovin's formula is then deployed to assess the sample size which comes to 381. This size of 381 is then divided amongst the strata pertaining to colleges decided in step 1. Accordingly 34 samples from Government Colleges that constituted 9% of the strata, 290 samples from Private – affiliated colleges that constituted 76% of the strata, 19 samples from Aided Colleges that constituted 5% of the strata and 38 samples from Deemed Universities that constituted 10% of the strata have been identified for the purpose of the study.

As the researcher wanted to throw light on differences in research productivity across different designations, the sample constitutes a mix of assistant professors, associate professors, professors and departmental heads. As far as the branches within engineering education are concerned, the researcher laid emphasis on the core branches (viz Mechanical and Civil Engineering Departments) and the branches with significant admissions (viz Computer Science and Electronics & Communication Engineering Departments).

Data was collected using structured questionnaires over a six months time period from May 2023 to October 2023. The questionnaire comprised of 24 items to measure various components of intrinsic motivation, measured through a Likert scale. The data later was analyzed statistically with the help of descriptive statistics, exploratory factor analysis and usage of multiple regression analysis.

### Scope of the Research:

The present research seeks to collect inputs from Faculty in engineering institutes only. Within engineering institutes, the research covers branches of Mechanical and Civil Engineering, Computer Science and Electronics & Communication Engineering. Moreover the research

covers engineering institutes in Bengaluru region. The selection of engineering institutes is based on ownership/funding and thus confines to four categories of institutes namely government colleges, private – affiliated/autonomous colleges, aided colleges and deemed universities.

Moreover though there are good number of indicators available to measure research productivity/outcomes, the present research tries to cover six major indicators namely publications, citations, grants/funding, guidance, book chapters and patents.

## RESULTS

### Significant Factors influencing Faculty Research Productivity

An Exploratory factor analysis (principal component analysis with varimax rotation) procedure was made use of to identify the most relevant factors influencing faculty research productivity/outcomes. Out of the 9 factors (subdivided to a total 24 items as measuring constructs) considered for the study, the following procedure was made use of to identify the most significant variables influencing research productivity, the details of which are furnished as below:

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.659
Bartlett's Test of Sphericity	Approx. Chi-Square	263.263
	df	36
	Sig.	.000

As evident from the above table, as the KMO value of 0.659 is more than a standard value of 0.5 and that the significance value is less than 0.05, it is hence proved that there is substantial correlation amongst the items in the questionnaire that seeks to establish a measure between various components of intrinsic motivation.

Communalities		
	Initial	Extraction
Career Goals	1.000	.712
Achievement Factors	1.000	.688
Drive	1.000	.825
Skill Acquisition	1.000	.922
Skill Application	1.000	.566
Research Subjects	1.000	.689
Research Aims	1.000	.791
Partner selection for Research	1.000	.502
Research Execution	1.000	.813
Extraction Method: Principal Component Analysis.		

Interpretation: As all the 9 factors have an extraction loading of more than 0.5, all are considered relevant for the purpose of further factors to be analysed.



**Component Extraction using Eigen Values:**

**Total Variance Explained**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.880	32.005	32.005	2.880	32.005	32.005	2.383	26.479	26.479
2	1.439	15.985	47.990	1.439	15.985	47.990	1.537	17.081	43.560
3	1.164	12.933	60.922	1.164	12.933	60.922	1.420	15.776	59.335
4	1.024	11.383	72.305	1.024	11.383	72.305	1.167	12.970	72.305
5	.705	7.836	80.141						
6	.648	7.196	87.337						
7	.562	6.249	93.586						
8	.345	3.836	97.422						
9	.232	2.578	100.000						

**Extraction Method: Principal Component Analysis.**

Interpretation: Of the 9 factors measuring Intrinsic motivation, 4 of them have an Eigen value of more than 1 and are thus considered for further analysis – namely rotation of factors.

**Rotation of Selected Factors:**

<b>Rotated Component Matrix<sup>a</sup></b>				
	<b>Component</b>			
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
Career Goals	.077	-.751	-.290	.243
Achievement Factors	<b>.671</b>	.482	.048	-.057
Drive	<b>.896</b>	-.129	.073	.018
Skill Acquisition	.100	.005	.087	<b>.951</b>
Skill Application	.301	.076	<b>.660</b>	.184
Research Subjects	-.001	-.021	<b>.828</b>	-.058
Research Aims	<b>.869</b>	-.001	.122	.144
Partner selection for Research	.510	.144	.390	.262
Research Execution	.093	<b>.835</b>	-.180	.272
Extraction Method: Principal Component Analysis.				
Rotation Method: Varimax with Kaiser Normalization. <sup>a</sup>				
a. Rotation converged in 5 iterations.				

Note: As evident, loadings that are more than 0.6 (bolded in the table) from the above table under each component are grouped together and ‘labelled’ with a new name. This becomes the final result / final factors that are considered the most influential ones amongst intrinsic motivation that influence faculty research outcomes. These factors are represented as below:

**Outcome of Exploratory Factor Analysis (Final reduced Factors):**

SI No	Factor (Labelled)	Components (From previous table)
1	Excellence in Research	Achievement Factors, Drive and Research Aims
2	Implementation	Research Execution
3	Research Focus	Skill Application & Research Subjects
4	Training in Research	Skill Acquisition

**Tests of Hypotheses (Multiple Regression):**

**Hypothesis 1:**

H<sub>0a</sub>: Career Goals, Achievement Factors and Drive (Purpose component of Intrinsic Motivation) does not influence faculty research outcomes.

H<sub>1a</sub>: Career Goals, Achievement Factors and Drive (Purpose component of Intrinsic Motivation) does influence faculty research outcomes.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.534 <sup>a</sup>	.285	.279	.469880000914849

a. Predictors: (Constant), Drive, Career goals, Achievement

**Inference:** As  $r=0.534$ , there is a strong relationship between purpose related factors and faculty research outcomes.

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.179	3	11.060	50.092	.000 <sup>b</sup>
	Residual	83.237	377	.221		
	Total	116.416	380			

a. Dependent Variable: FRP Avg  
b. Predictors: (Constant), Drive, Career goals, Achievement

**Inference:** As sig value of 0.000 is less than 0.05, regression model is a good fit.

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.141	.145		14.730	.000
	Career goals	.082	.038	.117	2.194	.029
	Achievement	.202	.039	.303	5.218	.000
	Drive	.147	.044	.202	3.374	.001

a. Dependent Variable: FRP Avg

**Result:** As the sig value of 0.029 for career goals, 0.000 for achievement and 0.001 is less than p value of 0.05, all the three constructs of ‘Purpose’ component significantly impact faculty research outcomes.

**Conclusion:** Thus null hypothesis is rejected and we conclude that Career Goals, Achievement Factors and Drive (Purpose component of Intrinsic Motivation) does influence faculty research outcomes.



**Hypothesis 2:**

H<sub>0b</sub>: Skill Acquisition and Skill Application (Mastery component of Intrinsic Motivation) does not influence faculty research outcomes.

H<sub>1b</sub>: Skill Acquisition and Skill Application (Mastery component of Intrinsic Motivation) does influence faculty research outcomes.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.586 <sup>a</sup>	.343	.339	.449883753768399
a. Predictors: (Constant), Skill Application, Skill Acquisition				

**Inference:** As  $r=0.584$ , there is a strong relationship between mastery related factors and faculty research outcomes.

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	39.910	2	19.955	98.595	.000 <sup>b</sup>
	Residual	76.505	378	.202		
	Total	116.416	380			
a. Dependent Variable: FRP Avg						
b. Predictors: (Constant), Skill Application, Skill Acquisition						

**Inference:** As sig value of 0.000 is less than 0.05, regression model is a good fit.

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.901	.070		41.272	.000
	Skill Acquisition	.152	.033	.319	4.626	.000
	Skill Application	.153	.035	.299	4.348	.000
a. Dependent Variable: FRP Avg						

**Result:** As the sig value of 0.000 for skill acquisition and 0.000 for skill application is less than p value of 0.05, both the constructs of ‘Mastery’ component significantly impact faculty research outcomes.

**Conclusion:** Thus null hypothesis is rejected and we conclude that Skill Acquisition and Skill Application (Mastery component of Intrinsic Motivation) does influence faculty research outcomes.

**Hypothesis 3:**

H<sub>0c</sub>: Choice of Research Subjects, Research Aims, Partner Selection and Research Execution (Autonomy component of Intrinsic Motivation) does not influence faculty research outcomes.

H<sub>1c</sub>: Choice of Research Subjects, Research Aims, Partner Selection and Research Execution (Autonomy component of Intrinsic Motivation) does influence faculty research outcomes.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.640 <sup>a</sup>	.409	.403	.427753324954433

a. Predictors: (Constant), Execution, Subjects, Aims, Partner

**Inference:** As  $r=0.640$ , there is a strong relationship between autonomy related factors and faculty research outcomes.

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	47.618	4	11.904	65.061	.000 <sup>b</sup>
	Residual	68.798	376	.183		
	Total	116.416	380			

a. Dependent Variable: FRP Avg

b. Predictors: (Constant), Execution, Subjects, Aims, Partner

**Inference:** As sig value of 0.000 is less than 0.05, regression model is a good fit.

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.066	.119		17.293	.000
	Subjects	.206	.020	.413	10.157	.000
	Aims	.115	.036	.174	3.174	.002
	Partner	.094	.040	.150	2.358	.019
	Execution	.082	.039	.137	2.121	.035

a. Dependent Variable: FRP Avg

**Result:** As the sig value of 0.000 for Research Subjects, 0.002 for Research Aims, 0.019 for Partner Selection and 0.035 for Research Execution is less than p value of 0.05, all the four constructs of 'Autonomy' component significantly impact faculty research outcomes.

**Conclusion:** Thus null hypothesis is rejected and we conclude that Choice of Research Subjects, Research Aims, Partner Selection and Research Execution (Autonomy component of Intrinsic Motivation) does influence faculty research outcomes.

### Findings

The present study intended to identify the most prominent intrinsic motivation related factors that impacts research outcomes of faculty in engineering institutes in Bengaluru. Of the nine main factors namely Career Goals, Drive, Achievement factors, Skill Acquisition, Skill Application, Research subjects selection, Research Aims, Research Partner Selection and Research Execution, the outcomes of exploratory factor analysis indicate that Four Factors namely – Excellence in Research (defined by Achievement factors, Drive and Research Aims), Implementation (defined by Research Execution), Research Focus (defined by Skill Application and Research subjects) and Training in Research (defined by Skill Acquisition) appear to be most influential ones. Thus these factors could later be confirmed in further studies leading to model development and validation.

Further, with an intent to validate the inter relationships between intrinsic motivation and faculty research outcomes as per the theoretical framework, the variables were hypothesized and multiple regression was employed. As per this analysis it can be inferred that (a) Career Goals, Achievement Factors and Drive (Purpose component of Intrinsic Motivation) does influence faculty research outcomes (b) Skill Acquisition and Skill Application (Mastery component of Intrinsic Motivation) does influence faculty research outcomes and (c) Choice of Research Subjects, Research Aims, Partner Selection and Research Execution (Autonomy component of Intrinsic Motivation) does influence faculty research outcomes.

## CONCLUSION

The present research has proven that intrinsic motivation largely influences research productivity of faculty. The purpose behind research, the level of personal mastery embodied by faculty in research pursuits and the extent of autonomy preferred by faculty while pursuing research are indeed worthwhile predictors of faculty research outcomes in engineering domains of mechanical, civil, computer science and electronics/communication. With the growing emphasis on research based performance assessment of faculty members in engineering institutes, the present study vouches to help policy makers develop a critical understanding of research motivation factors and help steer research goals of faculty. Moreover, faculty pursuing research themselves are to imbibe individual characteristics of self motivation, self efficacy and a drive to pursue significant research activities.

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