Understanding the researcher's role in enabling or inhibiting innovation clusters in emerging Indian economy

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Abstract **-** This paper presents a descriptive analysis to understand how researchers play a significant role within emerging innovation clusters. We highlight reasons that enable or inhibit researchers towards productization within scientific institutes in India. The paper focuses on understanding the above from a researcher's point of view by analysing their motivation and concerns.
Most research work from deep-tech computer science domains contain a shelf life when it comes to productization. Therefore, associated activities have a designated time period related to productization to avoid research leading to the product from falling into the Valley of death. As a result, researchers who work on projects resulting in potential productization become a crucial part of a successful research to productization flow of work.
Our paper develops an understanding of and evaluates different aspects of a researchers' journey as they relate to productization of deep-tech Computer Science research work.

Index Terms - Innovation Clusters, Productization, Emerging Economy, Deep-tech Computer Science, India

Introduction

India's booming innovation culture is evident in many IT fields especially in Computer Science. The cost-effective Silicon Valley of the world [5] also hosts a significant number of world-class research institutions that produce handsome volumes of deep-tech computer science research but most of these research efforts are unable to find a way to productise or become usable for a real world problem or market. This has resulted in a high volume of research work t having the potential to disrupt markets are unable to find avenues to fructify efforts.

The severity of the problem is only increasing year over year as new academia research work is unable to find any avenues to connect to innovation or productization efforts. While there are many facets that can inhibit this knowledge flow from lab to land, our research attempts to understand this thorny issue from a researcher's perspective. Using a defined survey questionnaire we underscore a variety of aspects that can enable/inhibit a researcher to further their research with productization efforts. This work attempts to understand the following about researchers and the research process

- Activities performed during research ideation stage
- Exposure to industry/domain experts during research execution
- Intent towards productization & its importance from a researcher's perspective.
- Reasons for lack of productization

In order to draw inferences to explain the above, we conducted the survey with 50 researchers pursuing MS & PhDs in computer science. The pool of researchers were identified by purposive sampling and the survey was conducted with researchers from top scientific institutes in India.

State of Indian Innovation Ecosystem

India prides itself to have the largest technical manpower in the world. It is on a rise of engaging and producing high quality research work in many fields. With the rise in the number of grade A institutions like IITs, IIITs, BITS, etc. that focus more on research curriculum - the volume of research work generated in these institutes is increasing every year [1].We also witness various innovation clusters shaping up around these research hotspots as institutions & governments are realising the importance & need of translation of deep-tech research to solve industry & real-world problems [2]. They are usually (but not limited to) of the following types:

- Technology Business Incubators (TBIs),
- Science & Technology Entrepreneurship Park (STEP),
- Innovation & Entrepreneurship Development Cells (IEDC)

Despite all of the above, there is hardly any research that is translated into industry consumable technology or productised to solve a real-world use case. This is an evolving problem getting bigger with time if not addressed now, resulting in a high volume of research work that has the potential of disrupting markets but are unable to find

avenues to translate the research into an application. As we get deeper into the functioning of these emerging innovation ecosystems we find an exhaustive set of activities or processes that can transform to enable the research translation flow from universities to market/industry. Following process flow shows different channels through which academic research can potentially travel from research labs to support various practical applications or market use cases.

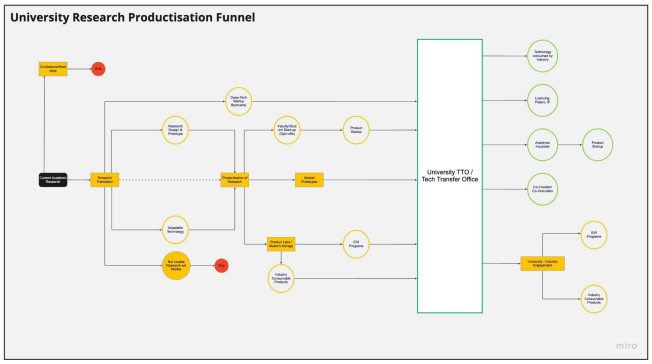

FIGURE I
DIFFERENT AVENUES FOR TRANSLATION OF RESEARCH FROM LAB TO LAND

While we see many productization channels available in the flow above, not many are accessible and functional among Indian scientific institutes. Interestingly, all these channels start from the 'Current state of Academic Research' which depends on the researchers who worked on these projects in the past or are currently working on similar projects. Hence, it is also important to understand how researcher's intent towards productization and support received for the same during execution of the research become a crucial part of our analysis.

LEARNINGS FROM SURVEY

This work is based on our findings and inferred learnings after conducting a 12 question survey with 50 researchers from top scientific institutes in India. The key questions asked as part of the survey were to understand the following

- The research ideation stage
- Opportunities to engage with Industry/Domain experts
- Importance of productization from researcher's perspective & their intent towards it.
- Reasons for lack of productization

Research Ideation Stage

In order to understand activities performed during the research ideation stage correlates to productization or readiness of research work for market/industry application, the survey probed respondents to answer: *How did researchers come up with their research idea?*

Interestingly, 36% of respondents mentioned that their research idea was based on a 'Real world problem'.

Among these 36% respondents, 83% actually consulted Domain/Industry experts to understand more about the domain compatibility of the technology/research being developed as part of their project.
While just 41% of these(83%) respondents actually worked on a prototype/productized version of their research in some capacity resulting in the productization effort as part of research work to just 12.2% out of all respondents.

The above implies on an average 1 out of 8 research work actually engages with productization as part of the scope of research work. On a separate note, we also witness that research ideas that emerge out of 'real world problems' have nearly 3 times more likelihood to have productization efforts planned suggesting a strong correlation between research ideation based on real world problems and productization efforts from researchers. (34.03% of researchers who worked on a project based on a 'real world problem' eventually worked towards productization of their research).

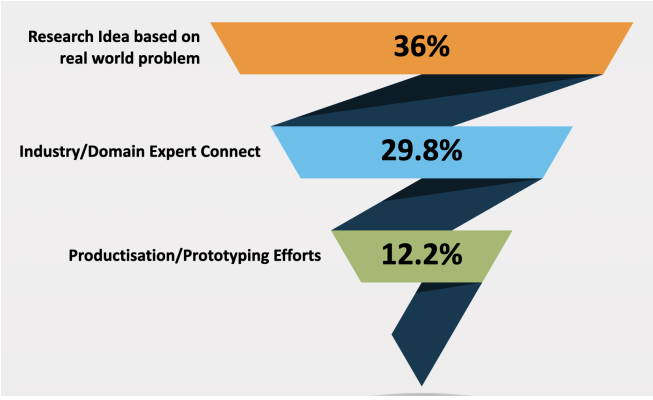

FIGURE II
3 LEVEL FUNNEL SHOWING CORRELATION OF RESEARCH IDEA STAGE TO PRODUCTIZATION EFFORTS

On a side note, it was interesting to see that 100% of respondents who didn't cite 'Real world problem' as part of their research idea eventually ended up not working on any productization activities for their research work. The latter suggests not having a real world understanding from the start of a research project would more likely lead to no productization.

Opportunities to Engage with Industry/Domain Experts

The survey also aimed to understand if the researchers had opportunities or avenues to engage with industry experts to understand more about domain compatibility of technology as output of their research efforts. We found that only 12.5% respondents identified that their 'research lab/institute had no connection with domain/industry experts'. Still 53% respondents didn't consult/networked with Domain/Industry experts at any point during the execution of the research project.

The survey also asked it's respondents to identify reasons for not engaging with Domain/Industry experts and following are the top reasons:

TABLE I
REASONS FOR NOT ENGAGING WITH DOMAIN/INDUSTRY EXPERTS

S. No.	Reasons (Multiple Choice)	Percentage
1	Not relevant to the success of research project	50%
2	Research is not relevant for current market	30%
3	Lack of Field Knowledge	30%
4	My lab/institute had no connection with the domain experts	12.5%
5	Confidential Research	5%

Most scientific institutes (if not all), have a tightly scoped requirement for the completion of MS or PhD degrees. These requirements are mostly focused around the academic importance of research, research paper acceptance in conferences/journals and not its practical applications. Therefore, 'Not relevant for the success of research projects' was expected as a top reason to de-emphasize industry alignment - as research institutes tend to ignore the importance of productization of research as part of their research project completion requirements [3].

The survey result also highlights that significant amount of 'research not relevant for the current market' tend to fall into Valley of Death [4] as there is no infrastructure or resources to ensure that industry aligned research is promoted for productization when they become eligible for industry applications.

Importance of productization from researcher's perspective & their intent towards it.

As India continues to emerge as a major economy, innovation clusters are emerging around research hotspots [5]. This setup provides ample exposure for entrepreneurial and translation possibilities for researchers to explore. Our survey result also shows a high intent from researcher's towards productization.

66% respondents showed that they were interested in productization of their research work.

But only 22% among these respondents, actually worked on any productization effort for their research.

The survey also probed to understand - *How important do researchers consider product view or prototyping isas a part of the research project?*

Researchers responded 3.65 out of 5 (on an average) to the importance of productization of their research work. This suggests that researchers are at large aware about the importance of productization and also have a high intent to work towards such initiatives.

Lastly, the survey also focused on understanding reasons for lack of productization.

Reasons for lack of productization

Our survey respondents were senior MS, PhD students and researchers who have completed research degrees recently. Researchers from the Computer Science domain largely tend to work in the Indian Technology industry either in deep-tech research roles or general software development engineering.

Following were the top reasons that researcher's responded for not putting efforts towards productization of their research work.

TABLE II
REASONS FOR LACK OF PRODUCTIZATION

S. No.	Reasons (Multiple Choice)	Percentage
1	Not essential for successful completion of my research	40.6%
2	Lack of Exposure Towards research based Entrepreneurship and Productization	28.1%
3	Not a Viable Career Option (would extend my research tenure)	18.8%
4	Have a job with an established firm	9.4%
5	My research has no scope of productization	9.4%

As we observe reasons for not engaging with domain experts and subsequently the lack of productization - we noted not having productization as part of research project completion requirement tends to be the top reason why researchers don't engage in such activities.

Lack of field knowledge as well as entrepreneurial resilience and exposure to productization and research based entrepreneurship curriculums [6] for researchers are impediments to developing the right skills and expertise needed for successful productization ventures based on specific research projects.

As the demand for top talent in Indian Tech roles rises, we also see a stark difference in monetary compensation that is offered to researchers in University labs versus what the MnCs and startups are willing to pay for their work. Typically, top tier Indian Computer Science research institutes (on an average) pay around 25 - 40 thousand INR ($275 - $525) per month while the same talent is compensated at the scale of $2,200 - $2,500 per month by the tech giants and startups. As a result, we see that researchers also identify prolonging their research tenure as 'Not a viable option' and therefore are more inclined towards completing their research work per University requirements.

Key Findings

- Researchers who consider real world scenarios during the research ideation stage eventually, have a higher possibility to engage in productization activities for their research work.

- Researchers primarily don't engage with domain/industry experts as it doesn't impact the scope and the process to complete research projects.
- Researchers show a high intent towards productization and understand the importance of performing such engagements for their research work.

- Researchers majorly don't engage in productization efforts primarily because it doesn't impact their project completion requirements.

- Researchers in the deep-tech Computer Science domain lack skills and expertise needed for pursuing their research as an Entrepreneurial venture.

- Lastly, Researchers don't see extending their research tenure for productization as a viable career option as there is a significant opportunity cost incurred due to the huge pay gap between the Indian Tech sector and University Research jobs.

Future Work

While this paper attempts to understand reasons that enable or impede productization of research in emerging innovation clusters in India, there is a huge yet passive productization flow that should be duly researched . Some of the burning questions we seek as future work are:

- Identify how University based research work can be blocked from serving industry applications. The productization flow mentioned in this paper (figure I) has many different stakeholders that can impact lab to land flow of research. Each of these channels are worthy of investigation to find the real impediments to research innovation.

- A subsequent study is also applicable to understand how Universities and Professors approach and impact productization within such innovation clusters.

- We also see scope for a financial evaluation and its impact in the long run for Universities for the missed productization opportunities based on their academic research portfolio.

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