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Bridging the Gap: Industry and Engineering Institutions through Efficient Collaboration

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***Abstract*—The engineering educational institutes strive to develop the graduating students to possess the skillsets required by the related industries in the market. However the industries, that seek the engineering graduates as their employees assert that they spend lot of time, money and energy in training these graduates. This fact emphasizes that there exists a gap in the skillsets cultivated in the graduates by the academic institutes and those required at the industries. The main causes behind this have been the differences in their major goals along with the lack of focused collaboration and efforts required to thin the said gap.**

In this paper we present a model namely 'Tailored Skills Development Model' (TSDM) which proves to be effective in bridging this gap. The model proves to be supportive to the engineering institutions where they are able to cultivate the graduates with advanced skills that are necessitated by the industries in the specific engineering disciplines focused by the institutes. And the model also assists the industries to seek the better manpower with adequate skillsets. The model helps to reduce the training period, related cost and energy involved at the industry levels in search of the anticipated skillsets. The paper discusses the organization and implementation of this model at our institute along with the statistics of its execution.

***Keywords*—Engineering education, Engineering institutions, Industries, Tailored Skills Development Model.**

***JEET Category*— Research, Practice**

I. INTRODUCTION

THE engineering education 4.0 (Ramirez-Mendoza R et.al. 2018) focuses on the use of advanced technology and automation in education to support the revolutionary growth of the industries and their demands. To cater for the requirements of industries (*Ind*s) of 21st century, majority of the educational institutes are striving to cultivate their graduates accordingly. Their main focus of work is on the streams like science, technology, engineering, and mathematics (*STEM*) (Ruamcharoen J. et. al. ,2021) for fostering the education in a better way. The engineering institutions (*EI*s) are also part of this radical change. The missions and the visions of most of the *EIs* state in general a common goal of developing the engineering graduates that are able to serve the needs of society at large by applying their skillsets and knowledge (van de Poel, I., 2009). One of the parameter of measuring the success of the *EI*s other than the parameters like entrepreneurs produced, researchers developed, students seeking the higher education etc.has been the percentage of the trained engineers getting placed at the various job positions offered by the related *Ind*s. Hence the *EI*s align all their educational, academic activities keeping in mind the recent and near future needs of the *Ind*s that are working or will emerge in the possible engineering arenas. Still a gap (Yinglun X et.al. ,2022) is observed between the *EI*s and the *Ind*s on the aspects of knowledge and skillsets pertained by the fresh graduates. The *Ind*s demand manpower pertaining very specific skillsets aligned with their products or services they deal with and the *EI*s board the graduates with generic engineering skills, abilities and the qualities. That is *Ind*s are typically vertically focused with very specific goals related to their growth, connect, cost savings, profit etc. and the *EI*s have been working on broadened, horizontal scope of overall development of the learners (Wolf M et.al. ,2022). Said this, the gap between the skillset-requirements by the *Ind*s and the skillset-establishment by *EI*s always exists. However it can be carefully, thoughtfully and creatively minimized.

In this paper we present a model namely 'Tailored Skills Development Model' (*TSDM*) which can be used in thinning the gap discussed. The paper also presents the results of the implementation of the model at our institute and states further the areas where the approach can further be strengthened.

The rest of the paper has been organized as stated further. The second section discusses the reasons behind the gap between the *Ind*s and the *EI*s. The third section describes the 'Tailored Skills Development Model' (*TSDM*) which can be operated collaboratively by the *Ind*s and the *EI*s. The section details the model with its organization, aims and benefits. The next section explores the implementation details and the last section highlights the conclusions and the further enhancements in the presented model.

II. THE GAP: INDUSTRY AND ENGINEERING INSTITUTES

When the missions or visions of the *EI*s are reviewed, we find a common thread that the generalized goal of them is to nurture the engineers who will be able to serve the society by applying their skills and the knowledge they have sought in their engineering education. The society is driven by the technological advancements and trends through seeking the products, tools or the services that the related industries produce. Hence the *EI*s strive to develop a curriculum which matches to the levels of the knowledge, skillsets and expertise mandated by the various *Ind*s. However, there exists a difference in the goals or the focus areas of both the *EI*s and the *Ind*s and the gap between the skillset-mandated by the *Ind*s and

the skillset-developed by the *EI*s always exists.

To reduce this 'skillset' gap various models or solutions have been developed by different *EI*s. Some of the related efforts can be found in (Jenefa L. et. al. ,2021), (Büth, L. et al. ,2017), (Rishika R. ,2021) and (Brahimi N. et.al. ,2013). The paper (Abdullah A et.al. ,2013) describes such efforts made at Faculty of Engineering Rabigh, Saudi Arabia. Another work (K. Alboaouh ,2018) highlights the roll of accrediting agencies in bridging the said gap and the work (Eileen G. ,2015) asserts the role of the engineering students in the process. The role of efficient course contents has been mentioned in (Anabela C. A. et.al. ,2013).

The *EI*s have a broadened goal of inculcating generic engineering skills like problem solving capabilities, computational thinking, analytical thinking and understanding the problems from viewpoint of design, cost, planning, execution, testing, deployment, restructuring etc. (Sambatur S. et.al.,2007), (Julian D. C. et.al., 2022). So the focus of the *EI*s, while developing the engineering graduates in on overall development of the learners by divulging them with quality education. That is, the *EI*s work in horizontal fashion with the learners aiming at their all-round growth as they approach their professional life.

The *Ind*s however, are typically very much focused on either a single product or a set of related products or services. The manufacturing or development of them demand peculiar knowledge and the skillsets. The general goals of them are to contribute in the process of qualitative product development, supplying innovative solutions with recent trends in the market, retaining and enhancing the customer base etc. That is their journey from product design to deployment is quite vertical.

Hence we often observe a gap on the aspects of the skillset and the knowledge levels observed in the graduates fleeting from the *EI*s and those demanded by the *Ind*s as their working fresh professionals. To deal with this, the *Ind*s go on investing money, time and energy to train the fresh graduates for the impartment of the required skillsets. The huge amount of internship or training hours result again at the *Ind*s. Hence there is a resilient need of some concrete solution or model or methodology that help the *Ind*s to save the cost, energy and duration required in training the manpower and make them job-ready.

After elaborating the goals of both the *EI*s and the *Ind*s we see that, the skillset-gap in discussion cannot be avoided however it can always be reduced, made thinner. To achieve the same, this work presents the 'Tailored Skills Development Model' (*TSDM*) described next.

III. TAILORED SKILLS DEVELOPMENT MODEL

The model described here has been the result of our efforts we take, at the department of Computer Engineering, K.K. Wagh engineering education and research institute, Nasik, Maharashtra, India. The model aims at reducing the described gap between the *EI*s and the *Ind*s and develop the job ready engineering graduates as per the needs of the IT industries. We term the said model as 'Tailored Skills Development Model' (*TSDM*) which has the following objectives:

1. Devising efficient process flow for interaction between EIs and Inds for the reduction in the skillset-gap observed.
2. Enabling the efficient collaboration between the EIs and the Inds for empowering the students.
3. Trying to shrink the time, energy, cost and monitorial efforts required at the Inds to train new manpower.
4. Improve the placement percentage at the EIs by triggering them to handshake with the Inds that demand the manpower with customized skillsets.

The model has been described next.

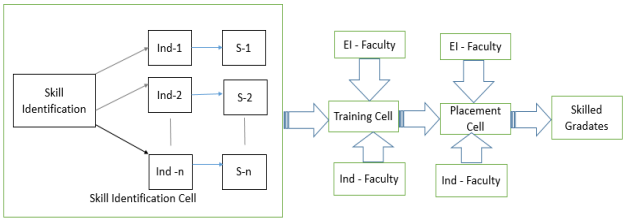

Fig. 1. Tailored Skill Development Model

The said model has three major components.

1) Skill Identification Cell

This is a component where the teachers from the *EI*s collaborate with the various related *Ind*s that are working with recent trends and are in need of the skilled manpower to work on the production or development of their products and services. The objectives of the skill identification cell is:

1. Carrying out the surveys through visits, meetings or communications in various Inds (say Ind-1,Ind-2..Ind-n) and identify the various skillsets (say S-1, S-2..S-n) required at their end.
2. Formulating a competitive curriculum to teach the graduates these skills, in collaboration with the experts at the Inds and EIs.

The outcome of these joint efforts is the list of elective subjects and/or the additional training courses which the third or final year engineering graduates do opt. These curriculums focus on imparting the apt levels of the knowledge along with the hands-on practice sessions. The formation of realistic, recent, feasible and practical curriculums is the key to the success of the model. Hence care is taken during formation of the contents of these courses. The implementation of these courses demand effective planning, the expertise, infrastructure, time and other resources. The training cell looks into this dedicatedly.

2) Training Cell

Once the skill identification cell ends up with its work, it provides inputs to the training cell. The objectives of this cell is to the effectual implementation of the training curriculums.

To attain this goal, the teachers from *EIs* and the experts at the *Inds* collaborate and agree upon the method of course conduction. The expertise from the *Ind*s and /or *EIs* conduct the training for the engineering graduates keeping in mind the ultimate goal of skilled manpower development. As this

training happens as per the *Ind*s requirements, during the academic period, the later need of investing time and monitory cost in training the manpower is saved. The graduates learn exactly what is demanded by the *Ind*s.

3) Placements Cell

At the end of the training curriculums, placement cell takes the lead. Its objectives is collaborating with the recruitment cells at the Inds and arrange for placements of the trained graduates at the Inds.

The *EI*s do optionally evaluate the trained students as per mandates of the university if the training course occurs as the university curriculum. The evaluation methods may include written tests, technical interviews, group discussions, practical demonstrations etc. As the evaluations end up the engineering graduates who exhibit the apt levels of knowledge and skillsets are placed in the related, collaborating *Ind*s.

With the successful implementation of the model the *EI*s achieve their goal of developing the engineering graduates with abilities and knowledge demanded by the *Ind*s and the *Ind*s benefit by getting the skilled manpower, reducing their time, energy and cost required later in the training the graduates that they seek. Thus, the *TSDM* model works for benefits of both the *EIs* and the *Ind*s. With the efficient implementation of the model, engineering graduates benefit a lot as they learn the specific, in demand and recent skills. The model enables them achieving this, in their academic schedule.

The next section explores the details about how this model had been implemented in our department and the related results have also been discussed.

IV. EXPERIMENTAL RESULTS

We implemented the *TSDM* in the period of 2015-2018. We executed two difference programs to implement this model. These were 1) The Oracle PACE Program: collaboration with KPIT Technologies Ltd. Pune (implementation period 2013-2017) and 2) The Infor, Singapore collaboration (implementation period 2018). The details have been explained next.

1) The Oracle PACE program: Collaborations with KPIT Technologies Ltd. Pune.

KPIT is a prominent software development and integration partner helping mobility leapfrog towards a clean, smart, and safe future. KPIT Technologies enables customers to accelerate the implementation of next-generation mobility technologies. The Oracle 10g technology is used widely during development operation at KPIT and they regularly hire fresh engineering graduates and train them in this related competencies.

Under this collaboration, the team from our *Skill Identification Cell*, communicated with KPIT Technologies Ltd. Pune and experts from both the sides discussed and identified the competencies which were the mandatory technologies that the computer engineering students need to possess to work in future on enterprise resource packages like Oracle, SAP etc. used in KPIT. The interactions resulted in a curriculum that demanded the nine day extensive training schedule based on the various trending topics like software engineering and Oracle10g database management, SQL querying, database administration, performance tuning of the databases etc. The curriculum implementation was called as 'The KPIT Oracle PACE Program' which was then offered to the students for next four years. This included total 12 sessions in each program.

In every year of this program, the interested computer engineering students from the final as well as third year registered for the program. The *Training Cell* included two teaching members from the department and expertise from KPIT who took collaborative efforts to train the students on agreed upon skillset. The students sought the theory as well as the hands on practical sessions. The practical assignments were carefully designed and the students implemented them all.

At the end of the course, the *Placement Cell* evaluated the performance of the students. This was evaluation of the projects which the students were given based on the curriculum. Also based on other academic performance the students were interviewed and then selected students were placed at KPIT, Pune. At the initial stage, the placement success percentage was observed as 36%. This enabled further refinement in the process of curriculum development, training, placements etc. The curriculum, methods of curriculum implementation and employment percentage got refined every year. And the last year's placement success was observed to be 100%.

The following figure depicts the success of the model implementation in the period 2013-2017.

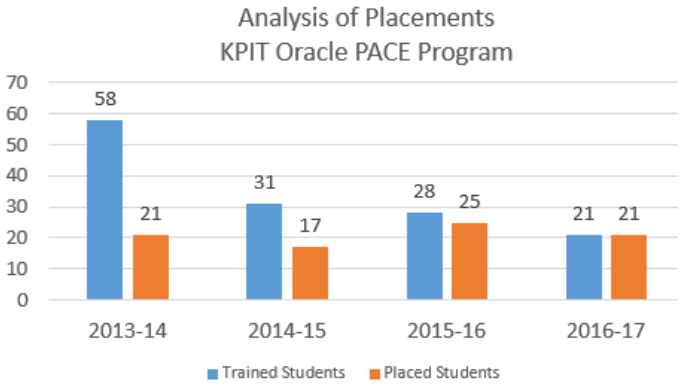

Fig. 2. The analysis of placement success: KPIT Oracle PACE Program

The number of students those were admitted to this program each year, varied due to factors like number of other parallel training courses, number of *Ind*s those approached to the institute for placements, selection criteria mandated by KPIT, number of required trainees by them etc. These factors mentioned however did not affect the quality of efforts carried out at our end.

The efforts of another collaboration with Infor, Singapore has been detailed below.

2) The Infor, Singapore collaboration

Infor, is a Singapore based organization that is building the

future of industry enterprise cloud applications. Infor's industry-specific ERP solutions have been meeting the needs of enterprise-level and small and medium-sized businesses for 30+ years. Infor ERP cloud software is securely hosted through Amazon Web Services allowing the businesses to quickly scale and spend less time managing infrastructure and more time focusing on strategic initiatives.

Our team at *Skill Identification Cell* identified this need of ERP management skills mandated in the majority of the leading software firms. Their interactions with Infor, resulted in decision that the graduating engineers need to be equipped with EPR management skillset. Accordingly, the experts from both the parties collaborated and designed a curriculum that was sanctioned as an open elective subject as 'Enterprise Resource Planning' by the Savitribai Phule Pune University and was included in the syllabus of final year of computer engineering from December 2018.

The *Training Cell* then received registrations from 30 students from that batch and six full day, on-campus training sessions were arranged by Infor for our trainers and the students. For the better exposure and understanding of the students the following efforts were made.

1) The training included an industrial visit to Liebherr Appliances Ltd, Aurangabad which is one of the reputed customers of Infor in implementation of the ERP products.
2) The expert talk session was arranged to discuss and resolve technical queries. The speaker was an industry professional from Samsonite South Asia Pvt. Ltd., Nashik which is another prominent customer of Infor.
3) Along with regular theory and laboratory sessions, a few online talks were arranged through Webx where director of Infor guided the students.

In the regular examination conducted by the university, all the 30 students, secured good marks and exhibited the virtuous impact of the skillset training imparted by the *Training Cell.* Although placements of the students was not ultimate aim in this case, the students benefitted from the learning the skillset demanded by the industries. The following figures depict the conduction efforts.

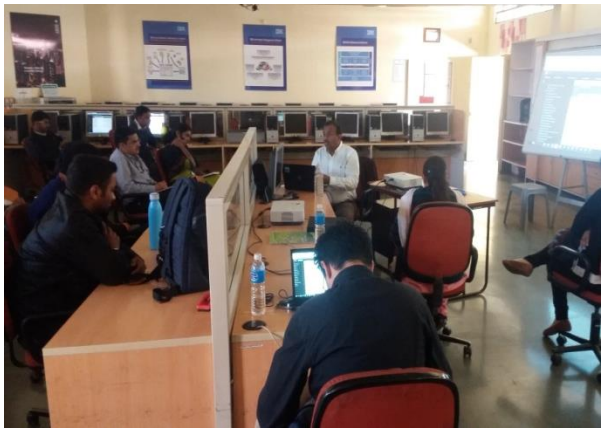

Fig. 3. The 'hands-on' training sessions for the teachers and the students.

Fig. 4. The conceptual training sessions for the students.

Fig. 5. The industrial visit of the students to Liebherr Appliances Ltd, Aurangabad which implements the ERP.

V. CONCLUSION AND FURTHER ENHANCEMENTS

In this paper we have presented a model namely 'Tailored Skills Development Model' (*TSDM*) which aims to achieve following goals.

1. Devising efficient process flow for interaction between EIs and Inds for the reduction in the skillset-gap observed.
2. Enabling the efficient collaboration between the EIs and the Inds for empowering the students.
3. Trying to shrink the time, energy, cost and monitorial efforts required at the Inds to train new manpower.
4. Improve the placement percentage at the EIs by triggering them to handshake with the Inds that demand the manpower with customized skillsets.

We implemented two programs under the said model, namely 'The KPIT Oracle PACE Program' and 'The Infor, Singapore collaboration'. In the first experiment we could bridge the gap between the SAP based organization KPIT, Pune where they could get the skilled graduates ready and aligned to working culture at KPIT. The skill-requirement gap was reduced, our department could deliver a placement success of 100% in the process. In the later experiment, we trained the students on the skillset of ERP which has been the in-demand technology at the various industries. The success of these efforts was exhibited

through the good performance of the students in the elective subject offered and by their later placements.

During the implementation, we also experienced that the success of *TSDM* depends on multiple parameters. The model can face shortcomings on factors like the lack of efforts by the skill identification cell where no enough industry exploration happens to look for the most recent skillset requirements in the *Inds*, the trainers employed by the training cell do not meet the level of expertise to train the engineering graduates, the ability of the placement cell to coordinate between the trainees and the *Inds* etc. Since all these cells have the crucial roles in the process, their level of efficiency determines the success of the implementation of *TSDM*.

In the coming years, we will try to refine our model to enable it to scale to increasing parallel demands by the multiple *Inds* demanding the common skillsets, conglomerate the training sessions having common objectives or contents, optimize the evaluation time and methods to accurately select the most deserving graduates opting for the most suitable industry. The new technologies which are in demand by almost all *Ind*s like Artificial Intelligence (*AI*), Machine Learning (*ML*), Data Science (*DS*) will be given more focus by the *Skill Identification Cell*. We also have plans to make permanent associations with the major seekers to make the process smoother.

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