Remote Utilization of IT Workforce (Women) Using Software Factory Model

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Abstract: There have been arguments that women cannot participate in IT industry economics and These arguments purport that a change in field will help them adjust in the economy. Because of dual responsibilities, women face difficulties in balancing out their work with their domestic and professional commitments. Frequently, they drop out from the field in the middle, producing a loss of a skilled resource in an organization. By introducing some new processes and methodologies, we can enable the women to participate effectively in the IT industry. In this research, we propose a methodology comprising of solutions from IT (virtual teams) and non-IT (football making industry) sectors. This in turn will facilitate female employees to work remotely, from home, with flexible timings and provide better quality work to industry along with better management. In our experimentation, we have found that communication overhead in remote working causes 18% delay, but this delay can be managed with proper training. After surveying, it has been concluded a workforce under this model would agree to work for 20% less wage. This wage variance in return, plus the business running cost per employee, gives the industry accumulative of 15% return per employee. This proposed model would effectively facilitate the IT industry in utilizing the full potential of the available resources (women) in this field, eventually leading to a stable economic growth.

Key words: Remote workforce • IT women • Virtual teams • IT economics • Utilizing potential • Software Industry

INTRODUCTION

There are arguments that suggest changing the field of employment is necessary to enable women or help women adjust there. Studies have shown that even though the IT industry is found to be an apt fit for women; there are cultural issues which give rise to women’s decision to work in industry [1]. Nielsen et al. term the women’s way of representing their work, experiences as dualities; home vs. work, IT work vs. sentiment, perception vs. analysis and so forth. It is no secret that women who join and stay in IT have to face immensely infuriating circumstances, most of which are completely cultural. Given the advances that women are making toward equality in other professional fields, the question arises: what is wrong with IT that it cannot retain women? How can industry help to accommodate women participation?

With advancement in technology, its work and product development rate increasing exponentially, which cause increase in team structure, style and models. Globalization has increased the need of skilled personnel; this has strongly commended software organizations to lower development costs and access to finest skilled resources, this lead using of global software development team as one of many possible solutions [3].

This research aims to provide a solution to increase the participation of women in software economic activities, by introducing some processes to work as a part-time or full time team-resource. This participation would aid in meeting the industry’s requirement for skilled personnel as well.

The following section II looks at the problem statement. Section III reviews some literature to highlight already suggested remedies; section IV describes the proposed methodology and section V with experimentation, how this methodology can be applied.

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Problem Statement: Less participation of women in IT industry because of cultural issues and less opportunities, cause economic forfeiture for a nation. To increase active participation of women in the economic activities of IT industry, the requirement is to build an effective software engineering model by using virtual teams and factory model concepts.

This Would Aid Software Industry By:
- Providing better management and quality work by using available talented resources effectively;
- Making team monitoring effective;
- Encouraging individuals to work to their maximum potential within their available work hours.

Literature Review: Women must be motivated or encouraged that their involvement will make a difference; that there is worth beyond the money and power, both for them and for the company. They must feel that they make a difference in some profitable way [2]. Education sector has improved in this regard; women are now taking part in IT as professional degrees but there is need to improve this participation in economy building.

In a report [5] by Suphia and Hafkin in 2007, few observations have been made:
- The number of female students enrolled in scientific fields is much higher than the number of women employed in industry.
- Women with degrees in scientific fields drop out of work at higher rate than women with degrees in other areas. (It is interesting to note that 79% of all IT jobs that happen to be at non-IT firms, round the clock dedication is the exception, not the regulation [2].)
- As compared to men, women with scientific degrees are less likely to be employed in their fields of education.

In a gender assessment in Pakistan report by World Bank in 2005 [6], only 25% of women were found to participate in active labor force. There were two main reasons deemed for this low percentage;
- Mobility Restrictions limiting access to opportunities
- Orthodox family practice decrees it unsafe for a woman. Statistics showed there are areas where women don’t feel safe while walking around.

WB has suggested that some micro programs that extricate women are likely to be more operative if supplemented by efforts to ease mobility limitations and concerned about safety. One case study [7] about Punjab work force has observed, that female labor force participation level is proportionate to the education level.

According to an analysis done in Pakistan and Texas-USA, there is no major difference in motivation of Pakistani and US women. Results turn out to be very interesting and peculiar as it was revealed that the cultural dimensions have a positive influence on both the working American and Pakistani females despite having glaring differences in their culture and other related aspects [24]. This study has shown that only 2% of both region’s females showed their interests in managerial positions.

Why Should Industry Care?: Globalization has increased the demand of technically skilled resources and it has been estimated that the cost to fill vacancy of an experienced, skilled resource is about 120 percent. In Asia, the retention concern jumps to 63% [11]. According to PASHA, Pakistan is ranked 2nd among South Asia IT industry. It says, women employment in Pakistan rises approximately 13.5% by 2007, raised from 8.9% in 2004, gathering an overall of 4.6% increase in 3 years [27]. Findings from the Global Software Development (GSD)’s resources requirement and the aforementioned statistics lead to an intense requirement of retaining the resources.

How Can Industry Help?: From an organizational point of view, flexibility is often considered as staying at workplace until midnight, with an expectation of increased productivity and continuous presence [11]. However employees who have children, find it difficult with round the clock workload. Employees also have to improve their technical knowledge and skills continuously at their own time. Mostly women leave the career track, finding it difficult to balance the IT work life with personal life, thinking they can return to the IT career but face a multitude difficulties at a different level. Wilen-Daugenti reported [11] that 66% of the surveyed women suggested a need apt career opportunities as to resolve retention problem.

Few organizations have started to provide such opportunities, especially to women who are not part of any organization or cannot work permanently in association with some company, because of the limitations described earlier. For example, several unpaid program like “GNOME Women’s Summer Outreach
“Free Software Foundation” and “Odesk/e-lance” provides the prospect to enthusiastic developers to work without being connected to any specific organization and handling all the complexities on their own.

**Why a Change in the Team Models or Organizational Structure Requires?:** A study [14] has shown improper knowledge management as the biggest challenge in GSD. It has pointed out:

- Lack of knowledge management in team cause disasters in project success.
- Team management and monitoring issues lead to delays in project, inefficient use of resources jeopardize the production.

By changing existing simple virtual team models to rectify above mentioned issues, we need to define team as per their roles and responsibilities. Contemporary communication technologies can help to reduce the management problem. This will aid to resolve the major communication problem in telecommuting. Studies have listed few best practices to make the remote team communication effective [26].

**Taking Benefits from Non-IT Industry:** The football making industry in Sialkot, Pakistan is a very important case study with respect to improving women participation in the workforce. Balls were stitched at home, providing an opportunity for women and girls to work at home, that comprised 66% of the total workforce. This process has some commendable features associated with it:

- Organization would not be dependent upon one family
- Work is distributed among families in chunks, thus if a deadline is missed by one family it will not make production vulnerable.
- Women and girls participate in the economy.

What if this kind of process would mix with software engineering models; what changes it would require and what other key issues can arise?

- How to manage and monitor the Project?
- How to distribute work?
- How to assure quality?

From a technical aspect monitoring of team requires hectic effort by the manager and the organization as monitoring a resource mainly affects its work quality in directly. Team work quality comprises six characteristics of; communication, mutual support, coordination, effort, a balance of member contributions and cohesion [4]. A team with better collaboration and shared understanding has an easier time to work in virtual environment. To be effective this communication needs to be monitored and controlled as well to have a better quality work in time.

**Local Industry Survey:** To gain insight of the local industry workforce’ experience, we conducted a questionnaire based survey. From this we learnt that almost 90% females want to avail the work from home opportunity. 54% of those surveyed were basing their positive response on previous experience of having already worked as remote member. Several other findings from our local industry survey is:

- Biggest motivation to do work in industry is to utilize acquired knowledge and be up-to-date with best industry practices. After that the focus is to earn with dignity.
- 54% women have already worked as remote team member and endorse it strongly.
- Type of work done by remote members: (1) Research and Development and (2) development only.
- For telecommuting, Skype conversation is used as the most common medium.

**Known Issues:**

- Technical help issues (related to specific task etc.)
- Non-Technical help issues like server got down
- Collaborative issues were less because of latest communication channel available.
- Other issues, which are not technical neither collaborative (some political environment cause troubles for remote resources).
- Resources choose to work in a silent place when doing work from home.
- 65% of workforce rank rewarded/compensation money as second motivation to do work.
- 96% of surveyed work force want to avail any opportunity which facilitates them to do work even by staying at home.
- 48% choose part-time working hours 4 or 6 hours daily to do work.
62% of respondents mentioned that they will manage time according to task. If necessary then they will synchronize their working time with team by choosing morning working hours. Correspondingly, their task status log will be of task based not on committed hours based.

87% respondents are OK if they have to visit office once a week.

One of the most common factors observed in our survey results is that all the females want to experience their acquired knowledge in the IT industry. Due to lack of prospects of work from home, all of them cannot work. From above information, we find the known issues and design our model strategically to provide solution to prevailing problem.

Only the existing workforce was not surveyed to collect data; a set of questions were asked from graduate students in leading universities of Pakistan. 80% of students expressed a desire to join the industry if it provides them work from home opportunity.

Hypothesis: From background studies, it is hypothesized that remote work force participation (part-time) can be effectively increased if task decomposition is done at discrete level (i.e., task is defined clearly); team is hierarchal/modular, team members roles are defined clearly; and we have provide proper training (technical and non-technical) to resources to work in such environment e.g., how to communicate with team either in office, or remote team member, how to seek help in case of any issue.

Proposed Methodology: Research has shown that lower participation of women in IT industry has resulted a large loss of national and individual investment. This turns out to be an organizational slack. To overcome this loss, it is important to develop some process and program where women are trained to participate in economic activities considering their limitations.

By merging two models, football factory and virtual teams, we are proposing a “Software Factory model”. Normally teams are structured in hierarchy/layers, making a pyramid showing an inverse relationship of skill of resources with the number of resources in each layer as shown in figure 1.

Proposed Team Structure: The team of software factory model is proposed to be structured as shown in figure 2. The organization is divided into two major parts:

- Core team (Project Manager, Architect, Designers, Quality Assurance lead and team lead/coordinator)
- Implementers (coders, quality testers)

The core team consists of upper layer of the pyramid, including manager, architect, designers (depending on the need), quality assurance lead and one team lead/coordinator. Each will have their designated responsibilities according to their skills and expertise.

Architect and Manager: The overall architecture of any project is being done and documented in collaboration by architect and project manager and this document will be passed on to the next layer of designers and Quality Lead.
Designers: They would do the detailed design on the input of Architect and PM, which will be reviewed by architect and other peers. This detail level design may include a class level design, including all the finer details of variables and procedural calls. Each of them will be assigned a number of programmers, to review the designed classes’ implementation done on daily basis and identify the errors if the work is not according to the standards (quality and designed). 200 LOC/hour or less is found to be an effective rate to identify nearly two-thirds of the defects on average in design reviews and more than half of the defects in code reviews [21].

Team Lead/Coordinator: TL/C is responsible for the communication between designers and implementers, though they can interact directly but to keep the monitoring efficient, they need to have an overall picture of the work which will be managed by TL.

Quality Engineer: As soon as design activity will be completed, quality engineer lead will build some test plans to check the quality of work.

Implementers: They have to do coding only, on the basis of the design provided by designers’ team. They can communicate with designer to discuss any particular implementation issue.

Testers: When Development is completed (either a use-case or a module), testers would do the testing of software as designed/planned by QA Engineer.

Proposed Process Model: Software factory process model is depicted in the following figure 3.

The separation of key resources made it possible for designer and implementers work as per their skills. This provides technical benefits of:

Better Quality:

- Forced design activity
- Consistency in code as per mentioned standards.
- Mentoring of implementers with respect to their work,
- Identification of areas in which training is required.
- Proper test-cases development activity and testing of each by a separate tester who will identify bugs and quality can be enhanced of particular implementer’s work.

Fig. 3: Software Factory Process Model

Better Monitoring:

- Management will know how much have been done and less chances of getting surprises by developer about task completion.
- For this, we are aiming to use already developed tool for our research experiment.

Less Payroll: Less overhead of programmer payroll, one does not need to be on fulltime basis. Providing an opportunity for women to work part-time resource while staying at home and managing their mobility restriction.

How monitoring and effective project management can be done in this model? With every activity, work is reviewed by other above layers, e.g. output is reviewed and approved by architect. Architects can give feedback on the work and about designer’s performance. Similarly, code review activity would not only check to meet the coding standard and design implementations but also gives an insight to the performance of an implementer. Whether he/she is working with slow or fast pace and how is he/she performing, identifying the training areas of worker. These feedbacks/reviews about resources will aid to improve the selection of resources for other projects as well as helps to make other projects’ estimates (effort and cost estimates).

Training Programs Required: In any remote team work environment, team communication and time flexibility concerns are of utmost importance. To assure an effective work environment resources need to be trained. The programmers at the last layer do not have to know about detailed algorithms, because finer work details are available and how programmers supposed to implement those. However, they need to know about basic programming and coding standards, so that they can learn any new technology if required. Similarly, quality
assurance resources required test-cases generation and test cases execution trainings.

We need following technical trainings for our resources:

- Basic Programming (concepts/languages/tools)
- Best coding practices and standards
- Test cases understanding and execution (Only for testers)

There are issues which do not come directly under the technical snags, like infrastructure setups and maintenance; but if one does not have expertise to resolve those, this would cause a major lag in work. These problems include troubleshooting the server disconnection, or no access to video conference call etc. The remedies are mostly less complicated and one can do steps to make things work. This semi-technical services training would be required to avoid any interruption in work flow.

Over time, it has been observed that team communication and collaboration are significant aspects for remote working models. Resources and teams should collaborate effectively to avoid any miss-communication delays. From literature we have listed few best practices for remote team communication, which will be part of interpersonal skill training. We need to train our resources for semi and non-technical aspects along with above mentioned technical trainings.

Employees’ Ranking: Review process of resource work will aid the process of resource’s ranking. We will have effort record of each resource with respect to tasks, this will give us the productivity measure. Each task will be logged with details of time estimation, actual time taken, documentation level etc. This data-graph will lead us to assign tasks to resources more appropriately. Resources will be ranked according to this progress graph after a certain time period, manager will review the resource’s performance and share this with him/her. He will guide the resource to improve weaknesses. He/she will earn points in this performance review. These ranking points will contribute to their performance level in organization. Promotions will have a different level and will not be as per current industry practices. Implementers’ will be promoted in terms of task type assignments. Due to the limitation of remote work, we are restricting design activity to be done by remote resource. But resource will gets promotion in 3 levels:

- Implementer will do only implementation of given design document
- Implementer will be given semi designed document to choose the basic data structures to solve the problem.
- Implementer will be given semi-designed document to choose the basic data structures as well as to choose the algorithm type to resolve the problem in hand.

After achieving all of these three levels, resource will be able to be part of design discussion with in-house team. At that time, he/she will have programming experience of almost 5 years which will help them to assess the IT problems and to give design suggestions to resolve these.

Identified Problems from Literature and Solutions from Proposed Model: From our research survey we have identified few problems, in current practices of remote working. Software Factory Model (SFWM) has solution to these limitations and problem.

Two issues were highlighted in our survey, both related to taking help from other team members or staff. Training is mandatory part of SFWM, which reduces the technical or non-technical urgent help requirement. Resources will be self-sufficient to resolve basic issues.

SWFM provides an efficient solution to utilize the knowledge and be in touch with industry even by staying at home. Resources can be used for best utilization time. Each resource will have some compensation of their work so that they would feel rewarded for their work done. And this model gives flexibility to choose the best resource for a specific task as per requirement in time.

Experimentation and Results: In order to study the impact and effectiveness of Software Factory Model, we have conducted a field experiment in a software company roughly of 75 employees in house. The company does work in Text Mining processing and works on products as well as projects. Products of the company developed by extensive research and development and projects are just the implementation of these products on different datasets. All clients are based in USA and a part of their management (Board of Directors) is in USA. This outsourcing has made it easy to conduct the experimental research for analysis.
A real time software industry environment was chosen, to properly assess the effectiveness and limitations of software factory model. All the details of team members, work type and resources productivity analyzed intensely to deduce results.

**Team Involved in Experiment:** We have taken 2 resources (A and B) as lowest layer of SWFM. Resource A is of 5 years’ experience and worked as remote resource (work from home 4 days a week). Resource B has 1 year experience and worked as in-house employee. Both are females with same level of education i.e., Masters Graduate from LUMS, they have some personal commitments for which they cannot work for long hours outside home.

We had one manager, one consultant as designer and one team coordinator for our upper layers, who are working in organization as full time resource and have extensive experience in respective domain.

**Data Collection:** In order to study the impact of SWFM, following tasks have been performed.

**Training of Resources:** Resources were briefed about task needs to be delivered by mentioned deadline, how will they log their work and how will they communicate with manager, team lead and designer (consultant) in case of any issue or discussion. Several best practices for team collaboration and communication [26] were delivered to resources to avoid any kind of misunderstandings. Consultants and managers were briefed about work review of resources to have quality results.

**Task Design:** To properly design and do work review of resources equally we have defined relevancy between tasks by decomposing work in categories mentioned in Table 1.

**Task Assignment and Review:** Resources were assigned task in a sequence and after each phase a detailed meeting with consultant and manager. The purpose of this meeting was to review the work and issues resources faced in order to implement the required task, as well as to measure the resources’ productivity for each task. Work quality from both resources was good mostly also acceptable to move to next sub task. Review of work does not involve critical coding standard’s check.

**Communication and Meetings:** Resources were told to coordinate through Skype, Email or Phone when doing work from home. As resource B is present in office, she can communicate directly as well. If there is an urgent need to have meeting for some issue other than planned meeting time, resource have to email and set up some time as soon as possible.

A remote resource can only communicate through Skype or phone call and she cannot do it frequently as in house employee. Therefore, stacked issues to be discussed cause unnecessary delays in work. Also our consultant’s availability is for lesser time. Initially scheduled meetings were not carried out due to his absence, which prolonged a small work/implementation issue from hours to days.

**Work Done Reports:** Management of resources is most critical task to do. To utilize resource’s skill efficiently, we need to have a clear picture of resource’s productivity for each task. For this purpose we have trained our resources to report about their daily work’s progress via Log Files. It contained estimated and actual time mentioned by manager/consultant and resources respectively. Also for remote resource, it was necessary to determine the work place so that productive hours can be observed clearly at both places.

**Quality Tests:** Work quality is major aspect of any development. IT industry tasks needs to be tested properly. Every business sets up teams to assure quality of the work. Quality test and work reviews are foremost aspect of this model as well. Both resources’ work has been tested and checked on different datasets as well by demonstration through GUI.

**Data Collection from Log File**

**Log File Stats and Comparative Analysis:** Table 2 shows the summary of log files stats. In terms of time logged and estimated, we formulated the data in table. But we need to compare the productivity of both the resources. For this
Table 2: Log File Stats Summary

<table>
<thead>
<tr>
<th></th>
<th>SWFM001</th>
<th>SWFM002</th>
<th>SWFM003</th>
<th>SWFM004</th>
<th>SWFM005</th>
<th>SWFM006</th>
<th>SWFM007</th>
<th>SWFM008</th>
<th>SWFM009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Logged (A)</td>
<td>0</td>
<td>5.16</td>
<td>17.92</td>
<td>2</td>
<td>79.49</td>
<td>6.75</td>
<td>6.76</td>
<td>23.78</td>
<td>0</td>
</tr>
<tr>
<td>Estimated Time (A)</td>
<td>1</td>
<td>5</td>
<td>15</td>
<td>2</td>
<td>65</td>
<td>6</td>
<td>8</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Time Delta (%) (A)</td>
<td>0.00%</td>
<td>3.20%</td>
<td>19.47%</td>
<td>0.00%</td>
<td>22.29%</td>
<td>12.50%</td>
<td>-15.50%</td>
<td>58.53%</td>
<td>0.00%</td>
</tr>
<tr>
<td>CV (A)</td>
<td>0.00</td>
<td>0.56</td>
<td>0.66</td>
<td>0.00</td>
<td>0.72</td>
<td>0.66</td>
<td>0.46</td>
<td>0.77</td>
<td>0.00</td>
</tr>
<tr>
<td>Time Logged (B)</td>
<td>25.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>106.5</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>7.5</td>
</tr>
<tr>
<td>Estimated Time (B)</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>105</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Time Delta (%) (B)</td>
<td>2.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>1.43%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>-6.25%</td>
</tr>
<tr>
<td>CV (B)</td>
<td>0.40</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.54</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Fig. 4: Time variance of resources

we have a graph with same parameters and calculated the time variance of each resource for listed task/sub-task type.

From fig. 4 we have observed that for each resource there is delay in SWFM008, SWFM006, SWFM005, SWFM003 and SWFM002. Remote communication (SWFM008) cause the maximum delta in time for resource A, i.e., 58%. In order to compare results of remote resource A with in-house resource B, we need to consider the tasks irrespective of SWFM008 dependency.

This time delta can be resolved with different communication strategies. Remote communication dependence on other task cause 58% of delta, we have seen exclusion of this task from log file without disturbing any dependency it results to 33% of delta for resource A.

After scrutinizing, when we exclude the 58% of these remaining task delta 33% to avoid dependency delay, we are left with 19% delta to deal with. To balance this approximately 20% extra cost, we can add 20% workforce, but this will add 5% extra communication line cost.

**Resource Cost:** Resources are major asset of any company, nevertheless we have a positive association between information technology (IT) investments and firm’s performance and results still vary across firms and performance measures [27].

Our findings have already shown this variance, resource A and B’s productivity. Delay in work or project deadline depends on project type, its complexity and client, so we cannot easily conclude the workdelay cost from our field experiment. But the question is why organizations bear this performance variance. To resolve this we have tried to do cost analysis.
**Business View:** According to the organization ABC, an average business/office running cost per resource is 10,000.00 PKR. No matter how much experienced resource is, this running cost comes under business running cost. This implies in our organization’s pyramid, lower level resources with less experience costs us much as compared to their salary. Now a days when fresh graduates hired as developers, they have W salary, but running cost of the business is almost \( X = \frac{1}{3} \) of W. This X cannot be reduce with respect to experience. What can organizations get from Software Factory Model?

Software factory model allows organization:

- To hire the fresh graduates as developer / implementers at lower wage Z.
- These resources will be working remotely for the time they will signed the contract.
- Hiring as implementers will have minimum running cost X.

Phrasing the above as a Mathematical Equation Then:

\[
W = \text{Normal wage of developers with less experience of (0 to 2 years) in industry}
\]

\[
X = \text{Running Cost of company for each individual} = \frac{1}{3} \times (W)
\]

\[
Y = \text{Remote resources added benefits cost, (health insurance, provident fund etc.)} = 15\% \times W
\]

\[
Z = W - X - Y = W - (0.33 \times W) - (0.15 \times W) = W - 0.48 W
\]

From above calculations, it costs approximately half of the wage a normal in-house resource take. Additionally we have to consider the cost in order to provide in-house working facility for resources. Companies need to maintain the space and office to accommodate resources on need. This concludes X cost will not minimize to zero. It will minimize up-to a fraction, depending upon the business or cooperate size.

In our informal discussions with management, Y cost may or may not be excluded. If we exclude this cost Z even then remote resource cost is less than W, hence giving a benefit to company to consume the resource capabilities in lesser amount.

**Resource View:** From our local industry survey we have 90% of females who wants to continue the work. But the question is at what cost? For any individual and professional, one has to go out for work and has to bear commute cost in terms of transportation fuel, maintenance and time and above all no time flexibility which accumulatively cost 20% of the salary.

Because of the diversity in experience of our participants and our analysis for X and Y cost’s fraction exclusion from W, we have average out Z cost as 20% less of W.

We have conducted a survey to find out how many of female resources agreed to work at home for 20% lesser salary. Results are satisfactory 70% of respondents have accepted to work. The remaining 30% said they will chose according to situation and work type. One respondent stated, she is already getting less salary and 20% less will not bear her expenses.

**Balancing the Work Delays and Resource’s Cost:**

Effective combination of resource’s capability and work type will yield best results. Trainings of resource will help in understanding the work type and communication lines hence will increase work performance. If collectively we see, this delay cost (one time cost at start for every individual, before proper training) can balance the full time resource cost who is taking higher salary and still have a chance of delay in deliverables.

**Results from Experiment**

**Advantages:**

- Software factory model (SWFM) provides well defined team structure. Role based team model reduce the team knowledge base structuring.
- SWFM minimizes the issue correspondence delay. Because of detailed documentation, resources will have to coordinate rarely with respect to problems in understanding issues.
- It provides individual an opportunity to do work for less hours, in turn leads to have a cheap workforce with equal benefits of full time in-house resource.
- It provides ways for organizations to best utilize available skilled resources.
- Resource based approach to best use capabilities for every assignment. Efficient usage of resources lead to minimize the domain training and learning time.
- Helps organization a way to retain its investment. Companies can retain those experienced individuals, who have spent a quality time in industry and have better understanding of IT problems. These resources can be role model for newly hired employees.
Streamline the processes, when employer and employee both want to have a win-win situation with this working model.

Participation of women becomes easy and economic growth will progress. Difference between number of CS graduates and working females will minimize. Also it will add the benefits of taking SEs work done at less cost hence assist IT industry to grow.

Quality of work always be ensured, at each iteration of task assignment previous work is being tested. Quality work will help local IT industry to gain position internationally.

Balance the work load and project because of project division into smaller tasks. No dependency on only one resource’s job, because every next task is given upon the delivery of previous tasks

**Limitations:**

- In growing industry it is difficult and costly to bear even one day’s delay.
- Resources have to be responsible and should put some effort to minimize the delay.
- Local IT industry of Pakistan, minimize the project development time by evading documentation of development phases. SWFM requires a detailed document for design and test cases, this task addition requires careful project planning and time estimations.
- At start of this working model, a comprehensive training required as a short step, which adds extra shift. It becomes problematic for company to accommodate this time.
- Employers and resource needs to be restrictive in terms of processes to make it successful. Teams should have to develop understanding in short time period, because resources are at remote site.
- Trust is necessary to be flexible for your colleagues.
- Employers have to maintain some work place to provide the facility of in house working.
- So far, we have learnt that for SWFM to be successful only experienced resources can work in this model. To accommodate any fresh resource, he/she needs to work as in-house resource for at-least an year, so that he/she have some awareness of IT industry work environment.

**CONCLUSION**

There is an enormous need to change the views that women cannot work in IT industry. Organizations cannot retain their best available resources who are dropping out from field only because of long working hours outside home. In this research, we have observed and listed few solutions to better utilize the resources, which require trainings of both in-house and remote personnel. Detailed documentation of each task minimizes communication overhead and provide the benefits of project details record. The workforce that cannot perform work outside home, but is skilled enough to work in the IT industry, are found to be agreeable to work from home for 20% less wage. This in turn gives net benefit of 15% to have cheap workforce with equivalent results. From our experiment we have concluded that this model requires following processes strictly to utilize the maximum of available skilled resources at lower wage.

**Future Work:** Field experiment for pure development tasks, with relatively larger team at implementation layer, designers and testers is mandatory to validate the findings of this research. Resources will be trained for a well-defined period to be comfortable in working with this model. Reporting mechanism will be less manual to add action items and expected time once on some shared platform for example Microsoft Team Foundation Server. Since performance reviews require a certain time period to do, we could not perform this in our experiment due to shortage of time. In future we are expecting to do experiment for long time to conduct this phase as well.

**REFERENCES**


