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#ITP4357

Competency Models for Human Resource Development: Case of Egyptian Software Industry

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ABSTRACT

It is now widely recognized that software technologies are the glue binding together communications, electronics, multimedia, and many other hi-technology products and services, and that the software industry is one of the largest and most pervasive global industries. The accelerated growth in this industry has created tremendous opportunities, but it has also presented a number of very tough challenges to the participants - for example, to ensure the supply of adequately developed human resources, to cope with speed-of-light technology changes. Hence, human resources and their development are becoming one of the main determinants of competitive advantage in the software industry.

This paper is in quest of building a competency model, or a group of preferred skills, for each of three selected roles in the software industry, namely junior software developers, senior software developers and project managers. Feedback from industry and academic professionals in Egypt was considered when constructing these models.

The developed models can be used in matching people with the right competency profile to the right job, planning their career path as of their studied abilities and developing their competency profile as planned.

As concluded from the developed models by the study, it is apparent that core competencies of software professionals, like mental skills, attitudes and aptitudes, usually differentiate superior performers from less proficient ones on the job. Development of these skills and competencies should be given higher attention rather than the sole focus on acquirement of current technical knowledge or just the assurance of having the proper exposure to some specific knowledge. Developing the modeled competencies would guarantee having the aimed for software professionals that developing countries can leverage to build some competitive market position in the highly challenging software industry.

RESEARCH FRAMEWORK

Background and Overview

The demand of the software industry is growing globally as of the new era of information technology. The industry is highly dependent on human skills as the main driving force for competitiveness and success. With the very high market dynamics and technology development, commitment to human resources development and career planning is not an option any more. Having competitive HR caliber, with the appropriate skill levels, is a key success factor for all players in the industry.

Some developing countries, including Egypt, having cheap and talented labor, have been looking into being players in the global software industry following the proven Indian success in the business. This necessitates that some proper attention should be given to optimizing the methods used for creation and development of competent software professionals.

Focus of the Study

This paper focuses on a single factor of production in the software industry, the human resource factor, which is one of the industry's most crucial success factors especially for the developing countries' case-in-point.

This paper tackles the skills needed by software developers, as they are usually the initial feed to other roles in a software firm. Furthermore, skills needed by project managers are investigated, in order to build a sample skill ladder that could be followed for career planning and development. Project management role is crucial in the software industry and needs to be highly proficient to assure the best work outcome.

Problem Definition

The study challenges the answer for the following inevitable question,

What are the core competencies that should be acquired by proficient software developers and project managers?

Research Importance

People with their creativity, innovation and productivity are the critical success factors and the valuable asset that countries are running after and putting lots of efforts to develop. Developing countries need to leverage their human resources asset, and develop it to possess the necessary qualities needed for assuring the software industry success.

Research Methodology

This study is based upon building three competency models, namely for project managers, junior and senior software developers. The methodology of devising a competency model starts

This paper appears in the book, *Managing Information Technology in a Global Economy*, the proceedings of the Inforrmation Resour es Management Association International Conference. Edited by Mehdi Khosrow-Pour.

by investigating the competencies of best performers on the job. Competencies are then defined and rated. For proper model creation and validation, thirty interviews have been conducted with industry visionaries in Egypt. Target interviewees were university professors, teaching assistants, and professionals both in the software industry and in related education and development establishments in Egypt.

THEORETICAL BACKGROUND

What is a Competency?

A competency is an underlying characteristic of a person which enables him to deliver superior performance in a given job, role or situation (Boulter, 1996). Competencies can be categorized as follows,

- *Threshold Competencies* are the characteristics, which any jobholder needs to have to do that job effectively. These do not distinguish the average from superior performer. For example, product knowledge for a software salesman is a threshold competency.

- *Differentiating Competencies* are those characteristics that superior performers have but are not present in average performers. For example, customer services orientation of a software salesman is a differentiating competency.

This study will focus on investigating the differentiating competencies of some selected software professionals.

What is a Competency Model?

A competency model is a selection of prioritized competencies applicable to a specific job. Competencies should be well defined and competency levels rated with appropriate criteria definition for each rating. Competency model is generally built based on the competencies of best performers in each job. This model can then be used for job related skill development, career planning and job/person matching.

HUMAN RESOURCES IN THE SOFTWARE INDUSTRY

This section will uncover the importance of human resources and the need for highly competent professionals in the software industry for sustaining successful business operations. Moreover, it links the human resources as a factor of production to the software industry and identifies the importance of human resources and its development to the industry for sustained competitiveness.

Definition of a Software Professional

By definition, software professionals are people engaged in systems analysis, design and development, programming and coding, database administration, and project management (Rajeswari, 1995).

Human Resources - A Factor of Production in the Software Industry

Knowledge, tools and software professionals are the main pillars in software production. Knowledge is the raw material of software development. Software tools help record and manage knowledge. It is software professionals who transform knowledge into software products using software tools.

The level of talent on a software project is often the strongest predictor of its results (Boehm, 1981), and personnel shortfalls are one of the most severe project risks (Boehm, 1988). Although the presence of an extraordinary individual on a project can have spectacular impact, there are not enough of these individuals to staff more than a handful of the projects in most organizations (Curtis, 1988).

In (Curtis 1988), two software vice presidents were quoted to highlight the importance of good professionals and the environment in which they work to bring software development projects to succeed.

"The most important ingredient on this successful project was having smart people...Very little else matters in my opinion...The most important thing you do for a project is selecting the staff...Really the success of the software development organization is very, very much associated with its ability to recruit good people."

"The only rule I have in management is to ensure that I have good people–real good people–and that I grow good people, and that I provide an environment where good people can produce."

Furthermore, increasing productivity in all phases of software development is an important issue that falls back to the attributes of people employed.

"Personnel attributes and human resource activities provide by far the largest source of opportunity for improving software development productivity." (Boehm, 1981)

Companies with the best workforce practices have been shown to outperform other firms in growth of profits, sales, earnings, and dividends (Boehm, 1981). Ultimately, the successful development of an indigenous Software industry is dependent upon the quantity and caliber of professionals that a nation can assemble to both compete in international IT market and use the IT knowledge to improve other sectors of its economy.

Necessity of Human Resources Development in the Software Industry

Increasing the knowledge, skills, and performance of software developers is necessary to have an edge over other competitors with comparatively lower priced talent in other countries. It is also crucial to satisfy the exponential explosion in the amount and complexity of software required by most current and future products. Furthermore development of software professional caliber would assist in increasing the quality and reliability of software production.

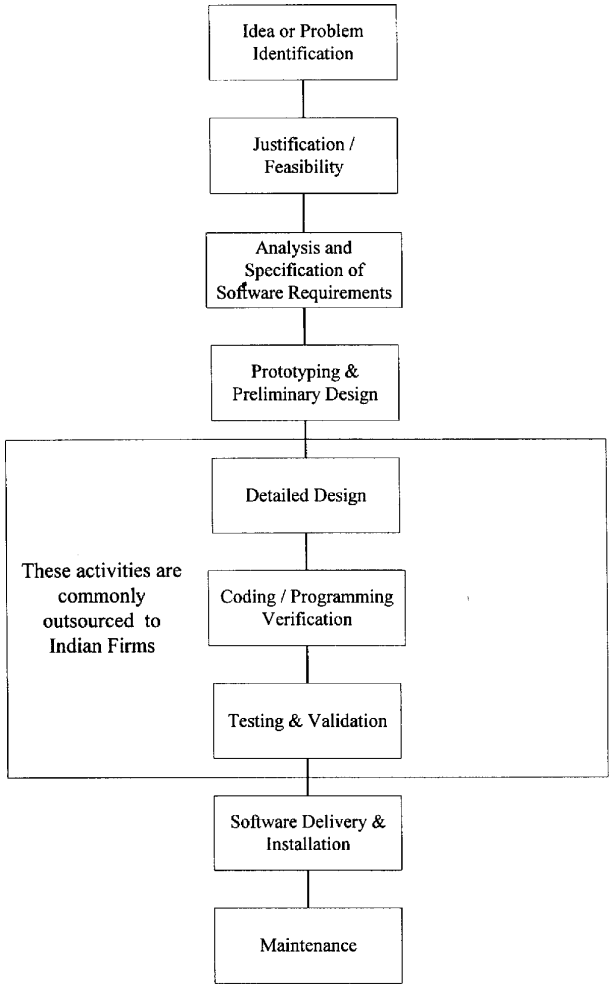
Software Companies and HR Development

Despite the importance of talent, human resources and other workforce practices, nevertheless most software organizations have moved slowly on improving them. They deployed development systems that are ad hoc or inconsistent, and software managers are insufficiently trained in performing them. Consequently, managers often expect their human resources departments to be responsible for the administration of most people-related practices. Compounding the problem, these practices are often applied with little analysis of their impact (Curtis, 1995).

Software System Life Cycle – Roles and Skill Levels required

Software development is seen as being broken down into a series of production stages, as shown in Figure 1.

Figure 1: Software System Life Cycle (Patane, 1994, and Heeks, 1996)



In practice these stages overlap and feed information to each other. During design, problems with requirements are identified; while during coding, design problems are found and so on. Software production involves a sequence of feedback linkages and iterations of the different activities.

These production stages form the basis for a skill division of labor. The earlier stages of analysis and design require higher levels of skill and experience, whereas those of coding and testing are relatively less skill-intensive but more labor-intensive (Heeks, 1996).

Software development and implementation represents one part of functionality within the software process. Quality assurance, marketing and sales represent some other parts of the software production cluster. As have been mentioned previously, this study attempts to focus on the software development role as it is usually the initial feed to other roles within a software firm, besides project management, which is one example of a career progress step taken by software developers.

BUILDING THE MODELS

Development of the Competency Models

A competency model is a selection of prioritized competencies applicable to a specific job. When looking for the best qualities of software professionals, opinions of industry visionaries must be considered. Visionaries assure that good programmers can become productive in a new software technology in a matter of weeks. As Garrent Bechler, a recruiter with RHI Consulting in Walnut Creek, California put it; "Any programmer who already knows C (the industry standard for the last 15 years), needs only a week, maybe two, to reach proficiency in Java" (Matloff, 1999). Furthermore Bill Gates has described Microsoft hiring criteria as follows: "We're not looking for any specific knowledge because things change so fast, and it's easy to learn stuff. You've got to have an excitement about software, certain intelligence. It's not the specific knowledge that counts.'' (Wall Street Journal, 1994).

Moreover, studies (DeMarco, 1987) show a dramatic 10-to-1 variation in programmer productivity, by virtually any criterion like time to finish a product, number of errors, and so on. In other words, the best programmers work 10 times faster and produce 10 times fewer errors than the worst ones which means, raw analytical talent, not paper credentials, is what really counts.

Opinions of interviewed industry visionaries in Egypt have identified with the above which concludes that current technical knowledge or exposure to some specific knowledge does not necessarily imply or assure having a good software professional. Obviously, familiarity with a given technology is a wonderful attribute in a candidate, but in the final analysis it's an extra, not mandatory. After all, given the vast evolution in technologies most software development technologies have a half-life of about one-year (McCarthy, 1995).

Defining Some Differentiating Competencies

Based on interviews with visionaries, business experts in the software industry and academic professionals, the following competency list has been constructed and identified to be the differentiating competencies that make superior performers on the job. The competency list is ordered alphabetically,

Table 1: Differentiating Competencies

	Competency	Definition
1	Client Orientation and interaction	- Ability to interact positively with a client. - Ability to put oneself in customer shoes and thinking how he sees things and communicate accordingly.
2	Coaching Skills	- Aware of the value of sharing knowledge and experience. - Makes time available to advise others when needed and provides assistance to less experienced members. - Can act as mentor by setting realistic and challenging goals for others. - Identifying development potential in others, while encouraging individuals to focus on their own advancement.
3	Communication Skills	- Expressing self verbally or in writing. - Relaying ideas effectively and efficiently using most suitable methods as per audience level. - Use of most suitable illustrative methods. - Listening effectively and speaking in a way that attracts audience. - Ability to absorb other ideas and respond accordingly. - Giving space to others to express themselves without interrupting them.
4	Conflict Resolution	- Ability to identify sources of differences that may lead to conflict and take steps to resolve them constructively (Hellriegel, 1998).
5	Cost Control	- Ability to control expenditure in an effective way.
6	Creativity & Innovation	- Openness to new alternatives, and challenging rigid thinking. - Ability to see the big picture and think laterally. - Applies technical and analytical skills to develop new methods & solutions.
7	Decision Making	- Choosing effective course of action on the basis of a thorough assessment of their short and long term effects and recognition of their implications (Hellriegel, 1998).
8	Definition of Objectives	- Ability to define achievable targets, goals and objectives as of proper situation assessment.
9	Delegation	- Accepting to give away work and responsibilities. - Realizing work through others.
10	Familiarity with the business	- Understanding of the software business and where his role fits in. Perception of the big picture and conception of the synergies between different roles.
11	Fast Learning	- Ability to understand and absorb new knowledge, concepts, skills and technologies in a relatively short time period.

Table 1: Differentiating Competencies (Continued)

	Competency	Definition
12	Human Resource Management	- Skill to manage and deal with people effectively as of informed knowledge of human nature and ability to understand characteristics of different people.
13	Industry Domain Knowledge	- Knowledge of some industry domain. For example communications industry, business, finance, etc.
14	Leadership	- Ability to establish a direction, create a vision of the future, align and motivate people to produce successful outcomes.
15	Methodological Thinking	- Following some methodological mental approach in thinking and analysis. - Devising a process in modular and structured stages. - Following planned steps in doing work rather than doing it in randomly.
16	Modeling and Design Skills	- Ability to model an idea, function or requirement into a modular hierarchy that can be interpreted afterwards by some software code to satisfy the need.
17	Motivating Skills	- Ability to create the drive within others to perform at their maxims.
18	Negotiation Skills	- Is the ability to discuss and propose specific terms of a possible agreement that renders benefit in a case when individuals and groups have both common and conflicting goals (Hellriegel, 1998). - Ability to convince others with some idea.
19	Performance against objectives & Goal Orientation	- Ability to collect action and work according to some preset objectives. - Staying focused on objectives without being driven away by other forces.
20	Persuasion Skills	- Conveying an idea to others in a way that changes their perceptions and beliefs towards some desirable direction.
21	Planning skills	- Ability to set goals, determine tasks to be carried out to meet those goals, assigning tasks to others, monitoring progress against the plan and revising the plan to reflect new information (Hellriegel, 1998).
22	Problem Solving Skills	- Identifying and separating various problems and resolving cause of each. - Ability of cause identification using cause-effect techniques. - Ability to focus on problem resolution under pressure.
23	Project Management Skills	- The application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project (Duncan, 1996).

Table 1: Differentiating Competencies (Continued)

	Competency	Definition
24	Quality Consciousness	- Believes in the value of quality. - Controls quality of output intentionally. - Does not compromise on quality.
25	Self Motivation	- Being able to motivate self and think of the better part of the future rather being demoralized by transient hard times.
26	Teamwork Skills	- Works effectively on teams by actively contributing to the accomplishment of goals. - Co-opting rather than competing. - Sharing knowledge and resources. - Giving credit to those who deserve it.
27	Technical Skills	- Ability to apply some specialized knowledge or expertise (Robins, 1998).
28	Time Management	- Ability to handle several tasks at once by being able to set priorities and allocate time efficiently.
29	Working under time Constraints	- Ability to stay focused under time constraints and to deliver output with the appropriate quality.
30	Working under work overload	- Ability to deliver effectively while having several tasks at hand that would exceed the normal workload. Output should be of appropriate quality levels.

Source: Author & Interviews

Categorizing the Selected Differentiating Competencies

For sake of further understanding of the differentiating competencies within the model, table 2 groups them under some broader titles

Table 2: Categorizing the Differentiating Competencies

Competency Categories		
Managing People	**Communicating with Others**	**Mental Skills**
Delegation	Client interaction	Creativity and Innovation
Coaching	Teamwork	Methodological Thinking
Conflict Resolution	Communication	Problem Solving
Human Resource Management	Negotiation	Fast learning Skills
Motivation	Persuasion	
Differentiating Knowledge	**Work Output Control**	**Planning Action**
Industry domain Knowledge	Cost Control	Definition of Objectives
Project Management	Quality Control	Planning Skills
Familiarity with the business	Goal Orientation	Time Management
Technical Skills	**Directing**	**Personal Attributes**
Technical Skills	Leadership	Working under time constraints
Modeling and design	Decision Making	Self motivation
		Working under work overload

Source: Author

Scaling Competency Levels

In order to give an indication of the different levels of knowledge and application skill in each competency, a scale will be used. This is demonstrated in table 3.

Table 3: Competency Levels Defined

Level	Level Attribute	Description
Very High	Expert	Expert knowledge and skilled application of the competency
High	Effective	Good knowledge and application of the competency
Medium	Elementary	Basic knowledge and application of the competency

Source: Author

Building the Model for selected Software Professionals

As demonstrated in table 4, development of the competency models is finalized by linking the relevant competencies, to the specific job roles selected. Furthermore, for each competency a proficiency level is given to identify the required competency mastery at that job role. The three models have been grouped in a single table to provide a skill ladder view for competency development.

Table 4: Developed Competency Models

		Junior Software Developer	Senior Software Developer	Project Manager
		Competency Rating		
	Competency List	**Level**	**Level**	**Level**
1	Client Interaction and Orientation.	N/A.[1]	High	Very High
2	Coaching Skills	N/A	Very High	Very High
3	Communication Skills	Very High	Very High	Very High
4	Conflict Resolution	Medium	Very High	Very High
5	Cost Control	N/A	N/A	Very High
6	Creativity and Innovation	High	Very High	Medium
7	Decision Making	Medium	High	Very High
8	Definition of Objectives	Medium	High	Very High
9	Delegation	N/A	High	Very High
10	Familiarity with the business	Medium	High	Very High
11	Fast Learning	Very High	Very High	High
12	Human Resource Management	N/A	Medium	Very High
13	Industry Domain Knowledge	Medium	Very High	Very High
14	Leadership	N/A	High	Very High
15	Methodological Thinking	Very High	Very High	Very High
16	Modeling and Design	High	Very High	Medium
17	Motivating Skills	N/A	High	Very High
18	Negotiation	N/A	Medium	Very High
19	Performance against Objectives and Goal Orientation	Very High	Very High	Very High
20	Persuasion Skills	N/A	Very High	Very High
21	Planning Skills	Medium	High	Very High
22	Problem Solving	Very High	Very High	Very High
23	Project Management Skills	Medium	High	Very High
24	Quality Commitment	Very High	Very High	Very High
25	Self Motivation	Very High	High	High
26	Teamwork	Very High	Very High	Very High
27	Technical Skills	Very High	Very High	High
28	Time Management	High	Very High	Very High
29	Working under Time Constraints	Very High	Very High	Very High
30	Working under work overload	Very High	Very High	Very High

Source: Author & Interviews

[1] N/A = Non Applicable competency to this job, or having low effect in promoting superb performance.

Application of the Developed Models

The developed models throughout the study can be used in:

- Job/person matching
- Long term career planning
- Benchmarking current competitiveness of professionals against modeled competencies

CONCLUSION

It was assured from the developed models that superior performance on the job was not attributed to knowledge of a hot technology or proficiency in a specific technical area. Given the high rate of technological development within the industry, deeper core competencies and abilities like mental skills and interpersonal skills were rated as the real source behind having high competent software professionals. Establishments in the software industry in Egypt should focus on developing these competencies to assure that Egyptian professionals would be able to deliver superior performance needed for sustaining a competitive position among developing countries in the highly dynamic and competitive software industry.

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