Career Development for Engineers – The New Social Contract between Management and Knowledge Workers

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Abstract

A new paradigm in management of human resources is being driven by the global internet economy. Career planning and development for engineers is moving toward a partnership with management that integrates organizational and individual growth and aligns them with the needs of the enterprise. In this paper, we describe a "Work Force Development" methodology which combines all the elements needed to forecast, define, develop and measure the critical skills and competencies demanded by the business. A process to design job descriptions, job families and career paths is presented and discussed.

Introduction

Hierarchical and directive management structures are breaking down in the new horizontal world of self-managed teams and project oriented companies. In the past, employees gave their loyalty and obedience to managers who developed and interpreted the goals, objectives and values of the corporation. Managers formulated the tasks to be performed and employees carried out their assignments as directed. The employee largely earned career advancement through loyalty, diligence and creativity in task execution. Job security was enhanced by a variety of factors including seniority, adherence to the corporate culture and values and performance in achieving goals. The implied contract stipulated that management provides the environment, tools and direction while employees focused on task performance. Management took responsibility for the success of the enterprise, while employees provided the skills, execution and productivity needed to accomplish objectives.

Downsizing, distributed decision-making and competition in rapidly changing markets are wreaking havoc with the vertical management structures of the past. Knowledge workers are not so neatly categorized as "technical" or "management" contributors and often function in multiple roles. Formerly, their knowledge and ability to do a specialized job measured the value of an employee. The company provided the system and environment that integrated all the various specialties into a cohesive work force to pursue specific business objectives. Employee development was focused on individuals and especially the "star employees" who were the top performers and prodigies in their areas of expertise.

As the implied contract breaks down, workers become more dependent on themselves and their teammates for security, advancement and direction. Today, an employee’s value is measured not only in specialized skills, but also by their teamwork, leadership and communication skills. Many companies pursue a range of business opportunities and the most valuable employees are those who contribute to projects across the scope of

business. Employee development is focused on team and organizational learning. Leading employees are effective at bringing new knowledge into the organization, envisioning its impact on the business and proliferating it quickly to all whom need to know. A comparison of the individual (old) and group (new) learning models is illustrated in figure (1).

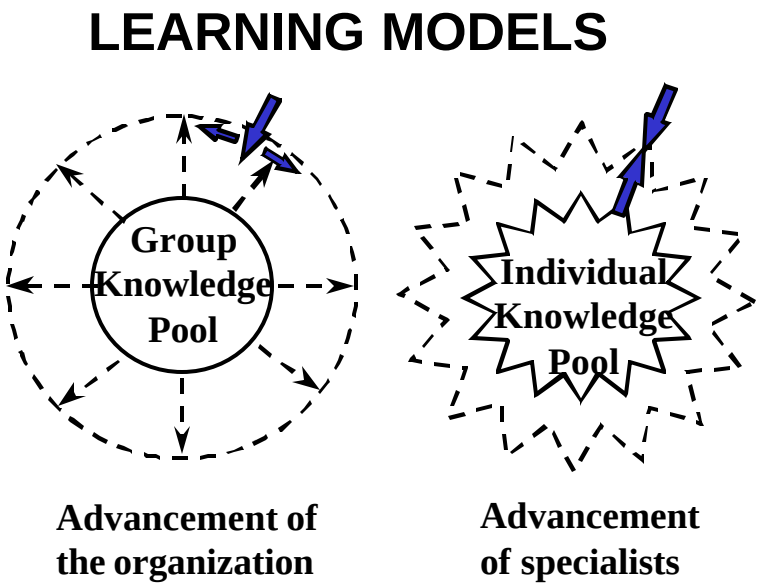

Figure 1

Under the evolving system, the implied contract will cast the engineer more and more as a business asset. Technical skills and specialist knowledge will still be important, but no longer sufficient. New roles as teacher, integrator, salesperson, project manager become important. Companies must learn to grow and nurture their people assets rather than simply wringing the most output from them. Effective management and development of people is as important as managing tasks.

As these changing roles emerge, we begin to see that an expanded definition of the engineer's job is at the core of career planning, both for individuals and organizations. Specialization will still exist, but advancement will come increasingly through successful performance in a broad range of functions that relate across the efforts of many employees working in the same environment with similar goals. We integrate these separate but related specialties and call them a "job family". Engineers will still have explicit job descriptions, but competencies and critical skills valued in a given job family will be important in determining their career paths. Management must clearly communicate the expectations for successful performance in job families in order to promote employee growth and learning. Open communication of these standards at every level of development including recruiting of new hires is essential to let engineers understand the requirements of both chosen and alternate career paths. Expectations

must be stated not only for the present, but perhaps more important for the future. Competencies and skills demanded by future business objectives must be forecasted as part of the strategic plan. "Human capital" planning deserves as much emphasis as finances, technology, products and physical resources.

Successful Strategies in the "Pioneering" Technology Era

Many of the entrepreneurs who built silicon valley and the technology revolution of the 60's and 70's were participants in development of basic sciences that are fundamental to modern life. Lasers, semiconductors, satellites, aerospace and other technologies that define our world today were derived from basic science and then applied in products that support today's standard of living.

The hallmark characteristics of successful leaders, technologists and other professionals of this generation included focus, discipline and unswerving dedication to the vision of products derived from the core sciences and technologies of which they became the proponents and evangelists [1]. Businesses, careers and reputations were built on the foundations of technical knowledge, specialization and devotion to task. Advances in computing, aerospace, communications, medicine, materials and many other fields were driven by single-minded pursuit of a product or technology vision drawn from the basic sciences.

Companies like Intel were founded and grew to prominence in such an environment - in this case following the famous "Moore's law" which relates transistor density to speed of semiconductor integrated circuit chips [2]. The company became dedicated to advancing microprocessor technology through focus on the PC market as the key source of demand for its chips [2]. Continued innovation in semiconductor processes and microprocessor design have propelled the company to first place among microprocessor suppliers and semiconductor companies in the world [2]. Business strategy was largely focused on doing whatever was necessary to advance the PC in order to stimulate demand for ever faster and more powerful microprocessors [2].

Forces Driving Change

The pioneering companies and leaders who created the original high technology industries and meccas of past decades are retiring, transforming or fading away as the "old economy" gives way to the new world of the internet, globalism and diversity of markets. As technologies and products mature, markets begin to saturate and the rate of growth subsides in accordance with the well-known "life cycle" curve. Companies must look to new opportunities for growth and profitability. The process is often painful and uncertain and many will fail to make successful transitions. Some fade, others emerge and many attempt to "reinvent" themselves by diversifying into new areas. Intel has proclaimed that it will change it's mission from "advancing the PC" to "advancing the Internet"[2], [3].

The ability of a firm to maintain leadership in its core business while creating or entering new areas is critical for successful "reinvention". Developing new businesses ranges from expanding the existing business charter to forming external partnerships to acquiring whole companies. These are demanding times for leaders, managers, and employees given the need to maintain the core products while being distracted by the need to "claw for market share" in growing new ventures [2]. Not only must expertise in new products and businesses be acquired, but even the character, culture and values of the firm may be impacted, especially if significant external resources are infused.

The staffing needs for companies in such transitional situations can present unique career development challenges and opportunities for everyone from senior management to new hires. The needs for technical competency, focus and discipline will not go away, but the abilities to deal with ambiguity, manage multiple tasks and take informed risks become important. Networking, multiculturalism and communication using diverse media are essential to operate in the global economy. A rededication to personal development and life-long learning is essential to keep pace with the continuous re-invention of corporate mission, products, businesses and technologies. Beyond personal development, employees must build and align group knowledge with the changing needs of the business.

Many companies such as Intel use a "building block" strategy in order to become pre-eminent infrastructure suppliers to entire segments of global commerce and industry such as the internet [2], [3]. This requires a level of "system thinking" that goes beyond the end product to address the total business environment. The "system" is no longer just the microprocessor or the PC. It is now the entire basket of products, technologies and services that support and enable the Internet user environment.

Career Development in the New Environment: Work Force Development

This complex business environment will drive changes in the human resource needs of "new economy" companies. Firms must nurture and manage their people assets as never before. We call these assets the "human capital" of the new economy. The new contract between management and employees will shift to a partnership arrangement. Managers must forecast and develop the capabilities of their organizations to perform new and critical missions. Employees need to understand the organization's evolutionary direction and align their own growth and development in order to be prepared for challenges and opportunities as they arise. All must be flexible to change with the needs of the business.

Work Force Development (WFD) is a closed loop human resource system which addresses the needs of both individuals and organizations to forecast, develop, define, measure and improve competencies, skills and abilities. A typical process is illustrated in figure (2).

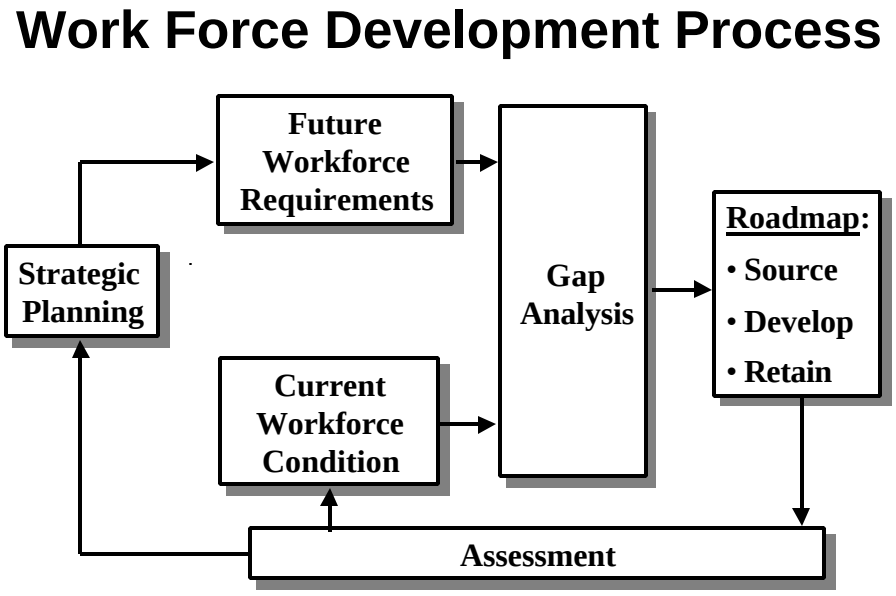

Figure 2

Such a system:

- Facilitates development and management of people as assets to meet business objectives
- Integrates and coordinates all people functions across the operating units of the organization
- Provides a context and roadmap for staffing, training and development
- Exhibits continuous improvement sparked by periodic forecast updates
- Is a powerful change management tool
- Informs employees of skills needed for success in performance of their job in their organization.
- Helps employees plan career development aligned with the business goals of their organization
- Allows managers to set employee development goals and track progress at group and individual levels
- Requires participation of all players: managers, content experts, employees and people specialists

Elements of a Workforce Development (WFD) System

Such an undertaking as the implementation of a WFD system involves fundamental, long-term changes in culture, attitudes and perspective on how planning and management of human assets is done. It's clear that the process must involve all the players, not just the human resource and related (staffing, training, etc.) professionals.

Changes like this do not happen over short time periods, nor are they effectively driven from "tops down". They must be embraced as the process of choice and as a priority for everyone. Managers, employees, knowledge experts and the human resources groups must all function as a team to plan and execute organizational and individual development programs. The players and their roles in the WFD system are shown in table (1). WFD is the platform, system and vehicle by which all employees of an organization develop and maintain the human capital and organizational assets the business requires.

WFD Roles & Responsibilities

Players	*Functions*	*Tasks*
Managers	**Develop capabilities to achieve business objectives.**	**Competency forecast** **Competency assessment** **Group Roadmap** **Tracking, evaluation and change**
Experts	**Deploy knowledge, skills and information to users.**	**Training content** **Teach, mentor and coach**
Employees	**Learn and grow in competency to meet business needs.**	**Personal dev. plan** **Adapt to group vector**
HR, Staffing, Training	**Provide systems tools and processes to enable people development.**	**WFD processes, tools and systems** **Training & development resources** **Facilitate the process**

Table 1

A critical WFD process is the definition of job skills and abilities based on essential functions and competencies required by the business. Table (2) shows this process flow, beginning with determination of the basic responsibilities of the job. Competencies are defined as capabilities to carry out these basic responsibilities. Critical tasks are determined by detailed analysis and breakdown of activities needed to perform the essential functions.

MAPPING SKILLS TO JOBS

Job Design	*Training & Development*
Job functions Key responsibilities of the job – primary areas of accountability ***Example:*** Write and execute product qualification plans.	**Competencies:** Abilities needed to perform job functions ***Examples:*** Ability to analyze data using reliability statistics Ability to devise reliability stress testing procedures
Tasks: Detailed steps required to perform job function ***Examples:*** Determine failure mechanisms Disposition product Analyze test results Select sample size Calculate reliability indicators	**Skills, knowledge and abillities:** Resources to perform specific tasks ***Examples:*** Use analytical tools (SEM, FIB, etc.) Apply MRB process Use SBL Apply lot acceptance curves Use BART tool

Table 2

We can determine the critical job skills via two paths. This allows verification of the job analysis. First, the critical skills can be derived by breaking down the detail of competencies needed to perform the essential functions. Second, the critical skills must equal abilities to perform the key tasks. When the results of these two analyses agree, we have derived and verified the skills, knowledge and abilities (SKA) needed to do the job. Once the SKA are determined we should be able to re-state key tasks and integrate them upstream to confirm the original essential functions. In a similar vein, we should be able to integrate the SKA upward to yield the original competencies. If either route fails to confirm the original functions, we may need to revise the basic job responsibilities based on this "bottoms-up" analysis.

The SKA and the WFD process are linked in a "chicken-or-egg" relationship. The SKA data is essential to initiation and maintenance of the WFD process, but the process steps are necessary to develop the forecast inputs for job analysis. In practice, we begin using best-known information and improve it in successive planning cycles. This yields a continuous process, which can be used to update and perfect job information for both managers and employees.

The benefits of the job skill analysis are:

- Managers can better align "human capital" needs with demands of the business
- “People development” personnel can identify new and emerging skills, knowledge and abilities earlier and prepare training before crises develop
- Employees have information with which they can better determine the path of their own career development

Implementing Work Force Development: Job Analysis for Manufacturing Quality

Quality and reliability engineering encompasses all aspects of Intel's business from product design and development to manufacturing to customer support. The quality and reliability engineer (QRE) does not function as a quality "policeman" but rather as the partner who brings to a team the skills and knowledge necessary to deliver high quality product and services on time and with flawless execution. The QRE skills and knowledge require not only statistics and sampling but risk assessment, assessing the business impact of decisions, influencing.

Implementation of a WFD system the quality and reliability (QR) network began with the creation of job families. Examples include product QR, technology development QR, and manufacturing QR. Each job family includes multiple jobs. For example, the manufacturing QR family includes components, assembly, test, and analytical QRE jobs. The jobs were the starting point for the job analysis process described above and illustrated in Table 2.

For example, team of experts and managers identified the manufacturing QR family job functions (Table 3). The team members were chosen not only for their QRE technical skills, but also for their understanding of business conditions, their business partners requirements and what skills and knowledge would be needed to support new business opportunities. Following the process in Table 2, they also identified over two hundred tasks performed in this job family. Each task was linked to specific training or resources to acquire the skills and knowledge needed to execute the task.

Manufacturing Quality Job Functions

- Business Quality
- Product, Process and Material Analysis
- Failure Analysis
- Technical Risk Assessment
- Product and Process Certification
- Transfers
- Excursion Management
- Quality Operating System
- Leadership and Management
- Manage Quality Information Systems
- Communication
- Presentation

Table 3

The result was a database of job functions, tasks, SKA and training for the manufacturing QR job family. Employees access this database to create individual development plans

for their career development. Program managers use the database to determine what skills a team needs in order to execute a specific project. Managers use the database to assess and close skill gaps in their current organization.

Conclusions

In the new employment paradigm, firms must manage "human capital" as a strategic asset and crucial component of the business plan. Managers must map out an organizational development path and align the careers of individual employees along its vector. Engineers will "own their own employability" by preparing to meet future business needs for critical skills, knowledge and abilities to meet the demands of the organizational development plan.

Work Force Development provides a process, tools and a platform for developing, executing, tracking and communicating both organizational and individual development plans. We have presented the basic WFD process and shown how critical job analysis tools are related as an important component. The development of a Manufacturing Quality and Reliability Engineering job family at Intel was used as an example to illustrate the application of this methodology.

The evolution and implementation of the new career paradigm through Work Force Development will not be simple, easy or quick. It will be cultural in nature and must involve participation of all the players as stakeholders including managers, employees, knowledge specialists and people professionals.

References

[1] *"Intel's Andrew Grove – Man of the Year"*, Time Magazine, pp. 46-92, December 29, 1997

[2] *"The New Intel"* , Business Week, pp. 110-124, March 13, 2000

[3] Intel Corp. 1999 Annual Report, pp. 1-12