RESEARCH OF CORE COMPETENCE FOR R&D PERSONS AT IC COMPANIES IN CHINESE TAIPEI

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ABSTRACT

This research extracts some essences of Intelligence Capital(or IC. here after) and refers them to aspects of key competence currently defined or used by different organization. Based on three developed IC indices, a theoretical and practical study aimed at the feature of technical creativity and key competence of R&D person at high-technology, especially IC(Integrated Circuit) companies has been followed. In addition, employees' education distribution from five high-tech enterprises(TSMC, Weltrend, Holtek, Realtek and Vanguard International Semiconductor) in Chinese, Taipei, were especially ranked at this research, as become the background of later proposed checklist, which will serve the purpose of key competence assessment for R&D personnel at Taiwain's high-tech enterprises particularly. At last, it is also suggested that enterprise should implement a set of standardized assessment to measure R&D person's key competence since recruiting. Thereafter, it consequently benefits, such as, R&D person recruiting efficiency, later technology driven speed, and may even reducing engineer resign rate , eventually keeps enterprise with good competition.

KEY WORDs: high-tech enterprise？core competence？attitude？intellectual agility

INTRODUCTION

In current day, high-tech industry receives dramatic competition just as area, R&D human resource becomes especially important factor for enterprises in promoting their competition. So far, there seems no suitable checklist for high-tech enterprise to evaluate what type of core intelligence should R&D human possess? This research, therefore, focus on subjects like, how enterprise analyze and evaluate core intelligence of their R&D person? What correlation exists between core intelligence and their future achievement? Are there some models or instruments can be used during recruiting R&D people? All subjects are points, which need to be concerned for all high-tech enterprises in Chinese, Taipei.

How enterprise recruit new R&D person efficiently become more important especially in economic recession time. For example, twenty years ago a sales manager of Casio left. Cost, including training and possible trouble cause of task disconnection, was equal to $185,000, while ten years later, it jumped to $418,000. In addition, the cost of absence, American enterprise needs at least waste $350,000,000 and more annually. Similar study at Chinese, Taipei also claims, cost at least NT1,500,000 for an electronic engineer quit out from high-tech enterprise. Besides that, many researches also point out that improper recruiting will increase human resource spending and other draw backs. Such as, employee resign, absence of illness, organization's bad work attitude, group counsel…etc.. Although engineer resign rate sometime is helpful for organization's human resource bringing up to date, it also costs a lot (Kao & Chan, 1999).

This research extracts some essences of Intelligence Capital(or IC. here after) and refers them to the aspects of key competence currently defined or used by different organization. Based on three developed IC indices, a theoretical and practical study aimed at the feature of technical creativity and key competence of R&D person at high-tech, especially IC(Integrated Circuit) companies have been followed. In addition, employees' education distribution from five high-tech enterprises(TSMC, Weltrend, Holtek, Realtek and Vanguard International Semiconductor), were especially ranked at this research, as become the background of later proposed checklist, which will serve the purpose of key competence assessment for R&D personnel at high-tech enterprises particularly. At last, it is also suggested that enterprise should implement a set of standardized assessment to measure R&D person's key competence since recruiting. Thereafter, it consequently benefits, such as R&D person recruiting efficiency, later technology driven speed, and may even reducing engineer resign rate , eventually keeps enterprise with good competition.

THE RESEARCH OF HIGH-TECH ENTERPRISES

Technology development and innovation has made economic evolution at this century significantly grown. It is more obvious at high-tech enterprises in Chinese, Taipei have created major economic efficiency at recent years. To begin with, high-tech enterprise at this research is first confined by four following dimensions (Ministry of Economic, 1998):

- Property: 1. New technology. 2. The technology with pioneering, international competition, the development of technology, and the improvement of marketing.

- Profile of enterprise: 1. The ratios of R&D cost in total production; 2. The ratios of employees' occupation; 3. The ratios of R&D cost and the technical levels of employees.

- Product of enterprise: 1. The amount of patents; 2. The revenue rate on innovated product sales; 3. The complexity of product and innovation.

- Overall: 1. High-tech employees, the ratios of R&D cost in sales quota, and the global market share; 2. The employee rates, amount of production, dependence, marketing, knowledge degree, power of production, related efficiency, the cost of R&D, the problem of money concentration, land, water resource, energy spend and pollution.

High-tech companies are encouraged with incentive from government and growth in a steady speed in Chinese, Taipei. The current condition trends to be in a mature period. To further march to new target of forming technology island. ? How to increase enterprise's R&D competence? becomes one of the most important strategy of enterprises in the future. Analyze from employees' condition in three consecutive years. Some common features, such as high education degree, young, and short working experience are found.

Profile of Employees (such as working department, average age, and average service duration).

Employees at the five companies mentioned before, including TSMC, Weltrend, Holtek, Realtek, and VIS, have the common characteristics of high schooling, young, and little working experience. We would get ideas for the characteristics of the employees from the annual report of these businesses(TSMC, 1998; Weltrend, 1998; Holtek, 1998; Realtek, 1998; VIS, 1998). (TSMC, 1998; Weltrend, 1998; Holtek, 1998; Realtek, 1998; VIS, 1998).

Table 1-1 -The Number of Employees (by position category) at TSMC

Year	Direct Employees	Engineering Division	Management Division	Total
1995	1,578	1,372	462	3,412
1996	1,830	1,715	572	4,117
1997	2,712	2,200	681	5,593

Table 1-2-The Number of Employees at TSMC

Year	Total Number	Average Age	Average Service Duration
1995	3,412	28	3.3
1996	4,117	28	3.3
1997	5,593	28	3.3

Table 2 -The Number of Employees (by Division Category) at Weltrend

Year	Administration /Finance	Sales	Technique	Total	Average Age	Average Service Duration
1995	6	8	39	53	30	2.6
1996	7	7	42	56	31.5	3.5
1997	6	7	48	62	32.5	4.2

Table 3- The Number of Employees(by Division Category) in Holtek

Year	1995	1996	1997
Engineer	454	609	894
Administration/ Sales	171	201	187
Technician	333	340	440
Driver/Guard/Janitor	12	12	12
Total	970	1162	1533
Average Age	28.5	29.7	30.6
Average Service Duration	2.8	2.9	2.8

Table 4 -The Number of Employees in Realtek

Year	1995	1996	1997
R&D	117(54%)	109(54%)	118(54%)
Administration/ Sales	76(35%)	71(35%)	74(34%)
Quality Controlling	24(11%)	23(11%)	27(12%)
Total	217	203	219
Average Age	31	31	32
Average Service Duration	4	4	4

Table 5 - The Number of Employees (by Division Category) in VIS

Year	1995	1996	1997
Direct Employee	1160	1007	680
Indirect Employee	731	581	361
Total	1891	1588	1041
Average Age	29.2	28.8	29.8
Average Service Duration	0.82	1.34	2.7

There are findings can be extracted from above tables. First, the average age of employees at theses companies are between 28 and 32.5 year-old, and have work experience from 0.52 to 4 years. Second, the population of engineers is higher than that administrative staff. Except that with professional context, the R&D of the technology needs engineers with the ability throwing themselves into product improvement and with unique creative thinking ability. From this point, it can be found that if employees with product improvement ability or potentials or ability to do the R&D job is important in the high-tech enterprises.

Profile of Employees' education

Employees at the five companies mentioned before, including TSMC, Weltrend, Holtek, Realtek, and VIS, have the common characteristics of high schooling, young, and little working experience. We would get ideas for the characteristics of the employees from the annual report of these businesses(TSMC, 1998; Weltrend, 1998; Holtek, 1998; Realtek, 1998; VIS, 1998).

Table 6 -The Ratio of Employees' education background at TSMC

Year	Doctor Degree	Master Degree	University/ Collage Degree	Senior High School	Under Senior High School	Total
1995	1.6	15.3	38.7	43.3	1.1	100
1996	1.8	19	37.8	41.3	0.1	100
1997	1.8	20	37.6	40.5	0.1	100

Table 7-The Ratio of Employees' education background in Weltrend

Year	Doctor Degree	Master Degree	University/ Collage Degree	Senior High School	Total
1995	1	5	39	8	53
1996	1	5	42	8	56
1997	2	5	42	12	61

Table 8 - The Ratio of Employees' education background at Holtek

Year	Doctor Degree	Master Degree	University/ Collage Degree	Senior High School	Under Senior High School
1995	0.1%	12.27%	54.12%	32.47%	1.03%
1996	0.6%	17.9%	53.53%	27.19%	0.77%
1997	0.65%	18.4%	56.88%	23.42%	0.65%

Table 9- The Ratio of Employees' education background at Realtek

Year	Doctor/ Master Degree	University/Collage Degree	Senior High School
1995	19%	60%	21%
1996	20%	58%	22%
1997	29%	51%	20%

Table10 - The Ratio of Employees' education background in VIS

Year	Doctor Degree	Master Degree	University/ Collage Degree	Senior High School	Under Senior High School
1995	45	214	418	356	8
1996	57	369	626	528	8
Growing Rate	26.6%	72.4%	50%	48.3%	0
1997	63	428	771	621	8
Growing Rate	0.1%	16%	23%	17.6%	0

In the beginning of high-tech enterprises, the original main human power is graduated from senior high school, college, and university. But it appears from above data that the trend is more and more needs to recruit more bachelor, master, and doctor to join this working field. Because R&D of high-tech company requires not only professional knowledge but also the ability in improving products and creativity. Therefore, high-tech industries value the importance of employees' potential talent in product improvement or in R&D. The developments of human resources mainly depend on the trend of enterprises' need; it makes business thriving and vigorous when raising the employees' capabilities and cultivating the core competency of business.

THE CORE COMPETENCE OF THE R&D HUMAN RESOURCE IN HIGH-TECH ENTERPRISE

The flourishing achievement on economical development in past 30 years in Chinese, Taipei have gained the international recognition. In recent years, because the prosperous development on industrial enterprises, many talent persons from ITRI (Industrial Technology Research Institute, a high-tech research institute sponsored by government.) were recruited to the private enterprises. The R&D capabilities have been improved(ITRI, 1998).

At the meantime, besides the output of semiconductor are the fourth place in the world, computer hardware get the third place, and many products get the first place of market share(ITRI, 1998). These achievements are contributed by the efforts of R&D staff and other members in the high-tech industries.

There are still several expectations for the R&D developments at the high-tech enterprises in Chinese, Taipei. So it is important to explore the core competence and its related theory of the R&D human resource in high-tech enterprise. It is going to be discussed by the following three dimensions, first is core competence, second is attitude, and the third is intellectual agility:

1. *The core competence*: Competence generates value through the knowledge, skills, talents and know-how of employees. And with the core competence, enterprise could surpass others' competition and get a new market share. The core competence, in this classification, indicates the technical or academic knowledge, which is belonging to enterprise's property. It represents some part of competition, but not all. One kind of core competence can create many kinds of product. One kind of product could also be created by many kinds of core competence. Only the company holder can decide which kind of monetary property or realty is belong to core or non-core property (Roos, et al., 1997). For example,

   a) At VIS (Vanguard International semiconductor, 1998), the core competencies are the process of product development and manufacturing of DRAM.

   b) The competitive advantages of TSMC is R&D for production process(TSMC, 1998) . The core competence of TSMC is on logical memory, advanced process module, CAD, and mask process, …etc.

   c) Holtek focuses on logical IC products (54.3%)(Holtek, 1998) . The rest of its products includes communication IC (9.2%), peripheral IC (8.7%), consumer electronic IC (36.4%), memory IC (12.5%), and wafer foundry (33.2%). Holtek's expertise is at diverse technologies of process, such as photo-electronic, high-voltage, special low-voltage, and non-volatile…etc. R&D for IC, Memory Process, 3C Integration, and System-on-wafer…etc. are all Holtek's core competence.

   d) Weltrend is doing business in the R&D, production, testing and sale of the products of digital & analogue combined application-specific IC (ASIC), Digital

IC and Analogue IC (Weltrend, 1998). Weltrend's products include Peripheral ICs, Consumer Electronics ICs, and ASICs…etc. Therefore, the core competency of Weltrend is focused on R&D and testing of electronic products.

e) Realtek is developing, manufacturing and selling the following products: consumer electronics ICs, peripheral & multimedia ICs, other ASIC and related application software（Realtek, 1998,）. Table 11 shows the sales percentage of all products and annual growth of Realtek in 1997. It also indicates the core competence of Realtek.

Table 11 -Realtek 1997 Annual Sales & Growth Report   (Unit: NT$ 1,000)

1997 Net income	*Consumer electronics Div.*	*Peripheral & Multimedia Div.*	*& Communication & Network Div.*
1,835,728	545,743	535,057	754,928
Sales (%)	29.8%	29.1%	41.1%
Growth (%)	22.5%	2.4%	40.3%

From above tables, it appears that the core competence can not be separated from enterprise's competition. And it also can be concluded by some examples of indicators in this competence field, such as :

- Percentage of company employees holding an advanced degree

- IT literacy

- Hours of training per employee

- Average duration of employment

2. *The behavior and work attitude*: knowledge and skills are not everything. Companies need employees who are capable and willing to use their skills and abilities to the advantage of the company and who can motivate the whole company to reach its goal.

Attitude, therefore, is a 'soft' component. The company has very little impact on this side. Attitude depends mostly on personality traits and therefore can be improved very little by company efforts. Attitude, primary included by three factors: Motivation, behavior, and conduct, covers the value generated by the behavior of the employees on the workplace(Roos, et al., 1997). And it also can be concluded by some examples of indicators in this attitude field, such as:

- Communicated with others very well

- Get along with others very well

- With work empathy

- Explore difficult problem with comrades to solve the problem

McKinsey and Procter & Gamble companies believe that the work attitude is at least as important as competence, and both have known to hire university graduates with non-specialist degrees(such as architecture, physics or humanities) and give them specific training afterwards: thus, they select an attitude in the candidates and then create the competencies.

3. *Intellectual agility*: In a fast changing world like ours, the ability to apply knowledge in very different situations, as well as the ability to innovate and transform ideas in products, is crucial to the success of a company. Intellectual agility indicates the ability to see common factors in two distinct pieces of information and link them together, and the ability to improve both knowledge and company output through innovation and adaptation.

Intellectual agility is tightly linked to competence, more so than attitude is. If competence is the content, intellectual agility is the ability to use the knowledge and skills, building on it, applying it in practical contexts and increasing it through learning. Intellectual agility can include the following wits, such as: innovation, imitation, adaptation, and packaging. Especially, innovation can create an ability on the basis of exist knowledge and push an enterprise successfully into a multiple goals.

Intellectual agility also has some examples of indicator, such as :

● Savings from implemented suggestions from employees

● New solutions/ products/processes suggested

● Background variety index(individual and group level)

● Company diversification index

CONCLUSION & SUGGESTION

Conclusion

As we know that the most popular IQ tests in the whole world are Binet & Wechsler(Wechsler,1958). It's for measurement and appraisal of adult intelligence. Since the evaluation tools were the product forty years ago. It also convinced us those tests are improper for test high-tech R&D person living in this high-tech era. Many scholars also doubt about the problems of intelligence recent years, such as, if the test with discrimination to different tribes, culture, educated or not …etc..(Hallahan & Kauffman, 1991). So the conclusion is that there is no such a proper instrument for measuring high-tech R&D person.

The core competence is composed by lots of knowledge skills and technologies. And with core competence, the enterprise could surpass comrade's competition and get into a new market. From above exploration it is found that the core competence can not be separated from enterprise's competition. And only the company holder can decide which kind of monetary property or realty belongs to core or non-core property.

Conclusion is made after exploring and studying on R&D human resource of several high-tech enterprises and related core competence theory. It is firmed if the enterprise can have a set of instrument to evaluate R&D people's core competence at the recruiting stage. It will help not only upgrade high-tech enterprises' recruiting efficiency, but also promote R&D person's technical creativity and enterprise's competition at market.

Suggestion

This research has explored the core competencies of the R&D human resource in high-tech enterprise. It's found that the key essences to impact the development of enterprise is if their employee's ability is equal to the core competence which is needed by the company. Therefore, It can be concluded and also suggested the items of the checklist for the core competence of the R&D human resource in high-tech enterprise after synthesizing the above theory and some high-tech company's employee performance assessment forms. The following lists five directions: The first is professional attitude and enthusiasm, the second is professional knowledge and ability, the third is communication/team work/ work with others effectively, the fourth is justification and problem solving, and the fifth is innovation and improvement. The following is items of the checklist for the core competence of the R&D human resource in high-tech enterprise:

1. Professional attitude and enthusiasm

●   Predicting and understanding the needs of the business, and managing it carefully.

●   Aiming actively to the content of business which is provided by the company, giving it an evaluation and according to the result, takes an improvement action plan.

●   Planning and participating every communication and coordination actively between tasks, smoothing the work proceeding.

●   Joining TQM activity aggressively, and applying TQM's concept at work to promote the quality of the task.

●   Demanding self to reach the request of work quality strongly.

●   Obeying the work standard when the work is proceeding.

●   Valuing and protecting the customer's Intellectual Property Right (IPR).

2. Professional knowledge and ability

●   Studying consecutively related professional knowledge and skills and applying it properly in order to reach the best performance.

●   Owning professional knowledge and skills to adapt current work needs.

●   Owning the ability of project management.

- Being able to definitely understand and develop the skills which can reach the needs of task.

- Being able to actively take timing, not to need to be pushed or waked, can keep time management and accomplish task of his part with alignment.

3. munication/teamwork/effectively work with others

- Being able to coordinate with other related department/person and make work smoothly proceeding.

- Being able to quickly learn how to do a new additional task and also can discuss with comrade about the difficult task and its steps.

- Having different ideal from comrades, still respect them and effectively work with different personality people to accomplish the achievement.

- Cooperating through teamwork, with the most effectively route to reach the achievement.

4. Justification and problem solving

- Analyzing actively which task should be improved, reasonably explaining and proposing a recommendation.

- Being able to apply multiple thinking method, reasonably justifies the source of problem, and finds the best strategy to solve the problem.

- Being able to perceive potential problem, prevents it before and after in advance.

- Being able to find the best idea to solve problem in an extremely short time.

5. Innovation and improvement

- Being able to improve and apply tried concept and method to solve problem under a new additional task condition.

- Being able to introduce the concept of new knowledge and skill into available program.

- Having the aspect which is over imagined for work innovation and improvement., and it really benefits to the task improvement.

- Being able to understand the same enterprises' activities and working methods, and can propose a more innovated method.

R&D person is contributing more and more influence to life of enterprise in this technology booming era. Enterprise needs ceaseless innovation to support highly competitive market. The cultivation of R&D person can not be accomplished in one day or one night. However, without a standardized assessment for enterprise's recruiting, the

loss is not only enterprise can not find suitable R&D person but also review. Sometimes hiring wrong person might badly retard progression. Therefore, how to aim at the feature of technical creativity and key competence of R&D person at high-tech and excite teamwork's cooperation to generate creative ideas or inventions with performance index are main target of this research.

At last, this research recommends a set of assessment tools to measure applicants' key competence when they are recruited and help enterprises select suitable R&D persons. It will benefit high-tech R&D recruiting efficiency, later technology driven speed, and may even reducing engineer resign rate, eventually keeps enterprise with good competition.

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