

Human Resource Development and Taiwan's Move Towards a Knowledge-Based Economy

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I. Introduction

After 50 years of achieving consistently high rates of economic growth Taiwan is now ready to enter the stage of development of its knowledge-based economy (KBE). Although the reasons behind Taiwan's previous successes in economic development are manifold, the island's well-educated workforce stands out as one of the most important contributory factors (Kao and Lee 1991). The purpose of this paper is to carry out an investigation into the role played by human resource development in Taiwan's developmental process. The particular focus of this study is on the adequacy of the existing system in Taiwan to meet its human resource needs, thus enabling it to enter this stage of high value added technology and of knowledge-based economy. The structure of this paper is as follows: 1. The development of Taiwan's human resources prior to the year of 2000; the development of Taiwan's human resources prior to 2000 can be divided into four period: the development of primary school level of human resources, 1950s, the development of junior high school level of human resources, the development of senior high school level of human resources, the development of college and university level of human resources. 2. The impact of rapid expansion of educational system on the quality of the workforce. 3. Current problems of human resource development system in Taiwan. 4. A new paradigm for Taiwan's human resource development. 5. Conclusions.

II. Human Resource Development in Taiwan prior to the year of 2000

The development of Taiwan's human resources can be divided into four distinct periods, as follows:

The Development of Primary school Level of Human Resources – 1950s

The development of Taiwan's primary school level of human resources can be traced back to the 1930s and 1940s, when the island was still under Japanese occupation. Japan set out to develop the primary education level of Taiwan's workforce because it felt that citizens with some minimum education would become good subjects, since they were able to follow the rules set by the Imperial occupying forces. When Taiwan was returned to China, the advancements already made in primary education provided a good basis for the National government to develop the primary school education. The Nationalist government placed a

high priority on the development of primary educational level of human resource by providing free and compulsory education for children between the ages of 6 and 12 years. By 1950, the Nationalist government had achieved its objective of enrolling more than 90 percent of boys of school age, and 70 percent of school age girls, into primary school education. In short, at the first four-year economic development plan the government in Taiwan had already accomplished its aim of developing its human resources to a primary school level, which is needed for the first stage of economic development.

The Development of Junior High School Level of Human Resources – the 1960s

Secondary education in Taiwan can be divided into junior high and senior high school, each of three years duration. The continuing development of Taiwan's human resources to a junior high school level of education came in the 1970s – with the subsequent development of senior high school level education taking place throughout the 1980s and 1990s. When Taiwan was under Japanese occupation, Japanese discouraged the expansion of education beyond the primary level because Japanese fear that better educated people would have greater ability to fight against the rulers. Thus under Japanese occupation the enrollment rate of 12-14 year old children into junior high school was negligible, but this increased rapidly under the Nationalist government. It enjoyed a double-digit growth rate during the 1950s and 1960s. By the early 1970s, the rate of increase in enrollment of 12-14 year olds had started to slow down, eventually leveling off in the 1980s, reflecting the achievement of universal enrollment within this age group during the mid-1970s. As the figures in Table 1 indicate, since 1975 more than 90 per cent of primary school graduates have gone on to enroll into junior high school. This rapid expansion in enrollment into junior high school during the 1950s and 1960s arrived at a very opportune time, since it was able to subsequently meet the much-needed human resource requirements for the island's development of its labor-intensive industries of the 1960s and 1970s.

The Development of Senior High School Level of Human Resources – the 1980s and 1990s

The development of senior high school level of human resource was achieved in the 1990s. By the mid-1990s, more than 90 per cent of all junior high school graduates were furthering their studies into senior high schools. Senior high school education system is divided into two distinct types of schools, academic senior high (ASH) and vocational senior high (VSH) schools. The function of ASH was to provide students with general academic preparation, through a curriculum which concentrated on the development of students' reading and writing abilities, along with a basic knowledge of natural sciences and mathematics.

The fundamental purpose of VSH was to provide students with a technical education. The majority of ASH graduates (88%) subsequently enter the labor market after graduation, with only a small proportion enrolling into the two-year technical colleges. In recent years the rapid change in economic structure has given rise to the greater demand for workers with more general training, rather than specific vocational training, since general training provides workers with a greater ability to learn new skills and the ability to

Table 1 The Development of Secondary Education

School year	% of Elementary School Graduates Enrolled in Junior High Schools (1)	% of Junior High School Graduates Enrolled in Senior High Schools (1)	School year	% of Elementary School Graduates Enrolled in Junior High Schools (1)	% of Junior High School Graduates Enrolled in Senior High Schools (1)
1952-53	34.85	56.96	1983-84	97.95	69.55
1955-56	43.94	63.13	1984-85	98.70	70.54
1960-61	52.24	75.88	1985-86	98.73	71.31
1965-66	58.23	78.52	1986-87	99.04	77.13
1970-71	78.59	82.66	1987-88	99.51	79.32
1971-72	80.85	69.62	1988-89	99.09	79.51
1972-73	83.31	71.17	1989-90	99.62	79.60
1973-74	83.71	67.90	1990-91	99.77	84.70
1974-75	88.03	67.57	1991-92	99.28	86.09
1975-76	89.47	65.82	1992-93	99.54	88.32
1976-77	90.41	61.57	1993-94	99.53	87.78
1977-78	93.60	60.04	1994-95	99.83	88.49
1978-79	94.08	60.42	1995-96	99.75	89.17
1979-80	95.58	62.75	1996-97	98.89	90.70
1980-81	96.14	65.16	1997-98	99.18	92.02
1981-82	96.77	68.11	1998-99	99.60	93.94
1982-83	97.96	71.52	1999-2000	99.89	94.73

(1) Figures for 1967-68 and before are numbers of students of graduating classes; those for 1968-69 and after are the numbers of actual graduates

Source: Taiwan Statistical Data Book 2000

adjust more readily to a new environment. Thus, the expansion of senior high school education, both in ASH and VSH, has provided a highly-skilled, technical workforce, enabling Taiwan to move into the new era of an economy dominated by skilled and technology-intensive industries.

The Development of College and University Level of Human Resources- 1980s and 1990s

The development of post-secondary level education amongst Taiwan's workforce was slow during the early period of the island's economic development partly because of the small number of colleges and universities and partly because a large share of college and university graduates went to United States or Canada or European countries for further studies. Once they completed their study a very large percentage of them remained and worked in countries that provided them with advanced training. However beginning in the mid-1980s more and more of these highly trained workforce started to return to Taiwan and helped to develop the high tech industries. As Table 2 shows, the proportion of high school graduates enrolled into post secondary education remained at around 40 per cent throughout the 1970s and 1980s, but rose to 66 percent in the late 1990s. The rapid expansion in the island's college-educated workforce came simply as a response to Taiwan's development of high tech industries and more so to the recent development of knowledge-based economy.

One unique feature of Taiwan college education is the higher concentration of them in the fields of engineering and business administration, with only a small proportion of them

being found in the humanities. As the figures in Table 3 reveal, during the 1980s, 28 per cent of all students in higher education were majoring in engineering, whilst close to a quarter were found in business administration. Less than 10 percent of all students were to be found in the field of humanities. By 2000, increasing numbers of students were entering the fields of business administration, mathematics, computer science and medical studies. Students are, therefore, clearly preparing themselves for the expansion of the e-commerce and bio-technological industries. In other words, thus far the supply of and demand for different types of human resources at different stages have been able to match.

Table 2 The Development of Higher Education

School year	% of Senior High School Graduates Enrolled in Schools of Higher Education (1)	School year	% of Senior High School Graduates Enrolled in Schools of Higher Education (1)
1952-53	26.27	1983-84	46.40
1955-56	44.27	1984-85	44.36
1960-61	43.41	1985-86	40.19
1965-66	38.30	1986-87	40.98
1970-71	41.92	1987-88	46.26
1971-72	43.47	1988-89	45.53
1972-73	42.62	1989-90	44.40
1973-74	37.92	1990-91	48.58
1974-75	39.68	1991-92	51.94
1975-76	39.80	1992-93	59.15
1976-77	42.39	1993-94	61.32
1977-78	43.59	1994-95	57.38
1978-79	40.43	1995-96	56.58
1979-80	43.96	1996-97	58.88
1980-81	44.64	1997-98	61.95
1981-82	45.39	1998-99	67.43
1982-83	46.03	1999-2000	66.64

(1) Figures for 1967-68 and before are numbers of students of graduating classes; those for 1968-69 and after are the numbers of actual graduates

Source: Taiwan Statistical Data Book 2000

Furthermore not only is there a rapid expansion in the number of college students in regular programs, but there has also been rapid expansion in the number of part-time college students enrolled in evening and weekend programs. Therefore the existing workforce has a good chance to pursuit continue and lifelong education thus constantly upgrading their skills and knowledge for the rapid changes of Taiwan's technologies and economic structure.

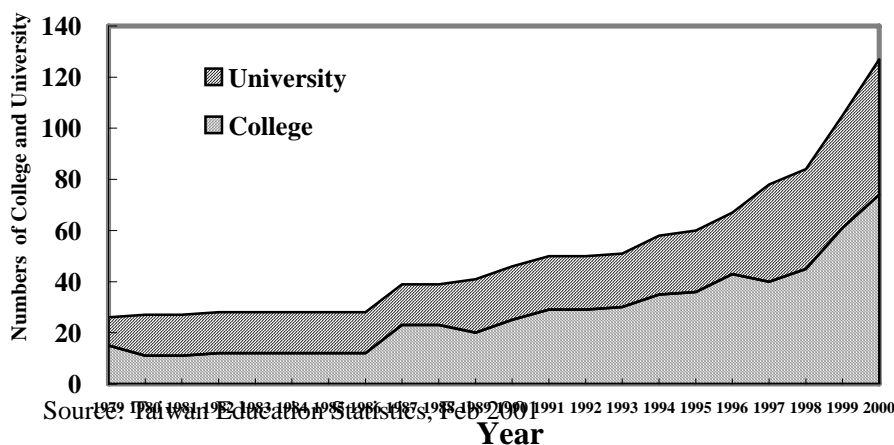


Figure 1 Number of Colleges and Universities (1979-2000)

Table 3 The Distribution of Students in Higher Education: by Discipline

Year	1983-1984	1990-1991	1999-2000
Total (N)	306,575	462,492	882,707
Total (%)			
Humanities	9.16%	7.10%	7.16%
Education	4.92%	5.88%	4.18%
Agriculture	3.39%	2.95%	2.53%
Law	1.63%	1.43%	1.13%
Social & Behavioral Sciences	5.24%	4.56%	3.53%
Natural Science	3.49%	3.25%	2.59%
Engineering	28.23%	30.16%	26.81%
Medical Science	6.92%	8.04%	8.76%
Fine Arts	1.98%	1.95%	1.95%
Mass Communications	2.39%	2.00%	1.57%
Service & Trade	0.75%	0.73%	1.43%
Transportation & Communications	1.19%	1.12%	0.97%
Home Economics	1.60%	1.85%	3.41%
Architecture	1.37%	1.33%	1.69%
Industrial Art	0.27%	0.33%	0.21%
Math & Computer Science	3.70%	4.91%	8.20%
Commerce & Business Administration	22.99%	21.70%	23.02%
Other	0.78%	0.69%	0.85%

* the Classifications for prior to 1983 was different. There for, they cannot be comparison

Source: Taiwan Statistical Data Book 2000

III. The Impact of Rapid Human Resource Development on the Quality of the Workforce

The rapid development of human resources of varying educational levels has resulted in the transformation of the quality of the island's workforce. As figures in Table 4 reveal, the average level of educational attainment of male workers rose from 6.2 years in 1965, to 7.3 years in 1975, with the trend continuing to 10.3 years in 1993 and 11.3 years in 2000. For female workers the improvement was even more impressive; the average duration of education for females rose from 4.9 years in 1965, to 6.2 years in 1975, 10.1 years in 1993 and 11.4 years in 2000.

Although the improvement in the quality of Taiwan's workforce was obvious across all occupations, the most rapid improvement was in the professional, administrative, sales/services and production categories; for example, in 1965, only 18 percent of males engaging in professional occupations were educated to college level or better, whereas by 2000, close to 90 percent of professionals had a similar level of education. None of the males in administrative occupations had any college education in 1965, but by 2000, more than half of this group had been educated to, at least, college training. This means that today, more than half of Taiwan's administrative workers have now received some professional training. As the rapid expansion of college trained workers in production work suggests that increasing numbers of these workers are no longer working on assembly lines, but instead becoming highly skilled workers and technicians engaged in roles where independent judgment and problem solving abilities are necessary.

Table 4 Distribution of Employment by Education within Occupational Groups: Males, 1965-2000

Unit: %

Occupational Group	Educational attainment						Ave. Years of education
	Illiterate & Self-taught	Primary school	Junior high school	Senior & Voc. High	College and above	Total (%)	
1965							
Professional	0.9	8.3	11.1	35.2	44.4	100.0	12.9
Administration	10.5	37.5	14.4	20.2	17.3	100.0	8.9
Clerical	2.4	18.6	18.6	41.9	18.6	100.0	10.8
Sales	17.0	54.4	16.4	9.6	2.5	100.0	6.5
Agricultural	28.7	63.0	6.1	1.9	0.2	100.0	4.7
Production	19.0	63.7	11.4	5.1	0.7	100.0	5.7
Service	19.7	45.7	15.7	13.4	5.5	100.0	6.8
Total (%)	20.9	55.0	10.4	9.0	4.7	100.0	6.2
Total (000)	571	1503	285	249	127	--	
1975							
Professional	0.7	7.2	6.6	33.6	52.0	100.0	13.4
Administration	2.4	35.3	12.9	21.2	28.2	100.0	10.4
Clerical	0.8	13.0	15.3	47.5	23.4	100.0	11.6
Sales	11.4	50.4	17.9	17.1	3.2	100.0	7.3
Agricultural	23.5	60.5	11.6	4.2	0.2	100.0	5.4
Production	8.8	57.9	20.0	12.1	1.2	100.0	7.0
Service	16.2	46.4	18.1	15.1	4.2	100.0	7.1
Total (%)	12.4	50.9	16.2	14.6	5.9	100.0	7.3
Total (000)	431	1769	564	507	205	--	
1988							
Professional	0.0	2.5	3.1	19.6	74.8	100.0	14.7
Administration	0.0	10.0	8.6	27.1	54.3	100.0	13.3
Clerical	0.3	10.8	10.8	39.0	39.0	100.0	12.5
Sales	2.6	26.3	19.0	34.3	17.7	100.0	10.2
Agricultural	13.7	56.3	17.7	10.7	1.6	100.0	6.5
Production	2.8	36.5	30.2	26.3	4.2	100.0	8.7
Service	4.9	35.0	21.7	29.3	8.9	100.0	9.0
Total (%)	4.1	32.4	21.8	26.3	15.3	100.0	9.5
Total (000)	209	1636	1099	1328	772	--	
1993							
Professional	0.0	0.8	1.2	5.9	92.9	100.0	15.7
Administration	0.3	12.7	13.4	33.3	40.3	100.0	12.4
Tech. & Assistant	0.1	3.5	6.6	41.9	48.1	100.0	13.5
Clerical	0.0	6.3	11.2	47.5	35.0	100.0	12.7
Service & Sales	2.2	25.6	22.5	36.6	12.9	100.0	10.0
Agricultural	10.3	51.4	21.8	14.2	2.4	100.0	7.1
Production	1.9	30.1	33.0	30.7	4.3	100.0	9.1
Total (%)	2.5	25.0	22.7	30.6	19.2	100.0	10.3
Total (000)	136	1357	1232	1658	1039	--	
1997							
Professional	0.3	8.6	13.1	33.9	44.2	100.0	13.0
Administration	0.0	0.3	0.3	2.8	96.5	100.0	16.9
Clerical	0.2	3.1	6.0	35.9	54.9	100.0	13.6
Sales	0.4	4.0	7.5	46.0	42.0	100.0	12.9
Agricultural	1.2	19.4	22.7	38.6	18.1	100.0	10.5
Production	9.2	49.2	22.3	16.2	3.3	100.0	7.6
Service	1.2	24.5	32.4	35.5	6.4	100.0	9.6
Total (%)	1.8	20.0	21.9	32.5	23.8	100.0	10.9
Total (000)	100	1127	1235	1832	1341	5635	
2000							
Professional	0.0	0.3	0.3	2.6	96.7	100.0	15.8
Administration	0.3	7.9	9.9	30.3	51.3	100.0	13.2
Tech. & Assistant	0.0	2.0	4.8	34.2	58.9	100.0	14.1female
Clerical	0.0	2.9	8.0	42.9	45.8	100.0	13.4
Service & Sales	1.0	16.6	23.3	42.1	17.2	100.0	10.9
Agricultural	8.2	48.6	23.8	17.0	2.3	100.0	7.5
Production	0.8	18.8	33.1	39.4	7.9	100.0	10.1
Total (%)	1.3	16.1	21.9	34.4	26.3	100.0	11.3
Total (000)	73	914	1241	1953	1490	--	

Source : Computed the Utilization of Manpower Resources, May Labor force Survey, various years.

Table 5 Distribution of Employment by Education within Occupational Groups: female, 1965-2000

Unit: %

Occupational Group	Educational attainment						Total (%)	Ave. Years of education
	Illiterate & Self-taught.	Primary school	Junior high school	Senior & Voc. High	College and above			
1965								
Professional	0.2	7.4	44.4	29.6	18.5	100.0	11.8	
Administration	27.3	54.5	9.1	9.1	0.0	100.0	4.5	
Clerical	1.7	13.3	28.3	46.7	10.0	100.0	10.6	
Sales	34.8	51.8	10.7	2.7	0.0	100.0	4.5	
Agricultural	49.5	48.7	1.8	0.0	0.0	100.0	3.2	
Production	18.5	68.9	10.5	2.1	0.0	100.0	5.4	
Service	34.9	59.3	5.8	0.0	0.0	100.0	4.2	
Total (%)	35.0	49.6	7.3	6.6	1.6	100.0	4.9	
Total (000)	355	499	70	66	16	--		
1975								
Professional	0.1	6.5	9.1	36.3	48.0	100.0	13.3	
Administration	1.8	17.9	17.9	53.6	8.9	100.0	10.7	
Clerical	0.6	7.1	14.7	62.8	14.7	100.0	11.7	
Sales	26.2	51.8	13.8	8.3	0.0	100.0	5.5	
Agricultural	50.3	43.3	4.6	1.7	0.2	100.0	3.4	
Production	11.2	62.2	20.0	6.4	0.2	100.0	6.3	
Service	20.2	59.7	12.6	7.6	0.0	100.0	5.7	
Total (%)	24.5	45.9	12.7	12.8	4.0	100.0	6.2	
Total (000)	418	782	216	220	69	--		
1988								
Professional	0.0	1.3	1.3	26.2	70.8	100.0	14.7	
Administration	0.0	16.7	16.7	33.3	33.3	100.0	11.8	
Clerical	0.2	3.8	5.8	59.2	31.1	100.0	12.8	
Sales	8.8	35.4	16.1	32.2	7.3	100.0	8.6	
Agricultural	39.8	48.9	6.7	4.0	0.0	100.0	4.0	
Production	8.2	39.1	28.3	23.3	1.0	100.0	7.9	
Service	9.9	41.6	21.0	24.4	3.1	100.0	7.8	
Total (%)	9.6	29.6	16.6	30.4	13.8	100.0	9.1	
Total (000)	295	908	508	931	422	--		
1993								
Professional	0.0	0.4	0.4	18.8	80.8	100.0	15.2	
Administration	0.0	13.0	13.0	37.0	37.0	100.0	12.3	
Tech. & Assistant	0.0	2.3	4.5	48.8	44.2	100.0	13.5	
Clerical	0.0	3.3	7.0	63.1	26.2	100.0	12.6	
Service & Sales	5.4	32.1	22.6	35.6	4.2	100.0	8.9	
Agricultural	30.7	51.7	9.7	6.9	0.7	100.0	4.9	
Production	6.5	42.6	26.5	23.0	1.3	100.0	7.9	
Total (%)	5.8	25.0	15.6	35.1	18.6	100.0	10.1	
Total (000)	192	830	517	1165	619	--		
1997								
Professional	0.0	8.1	9.7	32.3	50.0	100.0	11.5	
Administration	0.0	0.4	0.4	16.4	82.9	100.0	13.7	
Clerical	0.0	1.5	4.4	39.6	54.6	100.0	12.6	
Sales	0.0	3.8	6.3	55.5	34.5	100.0	12.2	
Agricultural	3.6	25.9	22.6	41.0	6.9	100.0	8.9	
Production	28.9	52.7	11.7	5.9	0.8	100.0	5.4	
Service	5.1	37.0	28.6	26.9	2.4	100.0	8.0	
Total (%)	4.1	20.1	15.4	35.7	24.7	100.0	9.8	
Total (000)	146	722	555	1281	889	3593		
2000								
Professional	0.0	0.0	0.0	11.1	88.5	100.0	15.5	
Administration	0.0	6.8	6.8	32.2	52.5	100.0	13.3	
Tech. & Assistant	0.0	1.1	2.6	36.9	59.3	100.0	14.2	
Clerical	0.0	2.3	5.2	53.1	39.4	100.0	13.3	
Service & Sales	2.7	22.1	22.1	44.4	8.6	100.0	10.0	
Agricultural	23.8	52.5	14.9	7.4	1.0	100.0	5.5	
Production	3.6	32.4	28.8	31.8	3.4	100.0	8.9	
Total (%)	2.8	16.5	14.5	37.2	28.9	100.0	11.4	
Total (000)	106	632	556	1423	1106	--		

Source: see table 4

Table 6 Distribution of Employment by Occupation within Educational Groups, Males, 1965-2000

Unit: %

Occupational Group	Educational attainment						Total (%)
	Illiterate	Self-taught	Primary school	Junior high school	Senior & Voc. High	College and above	
1965							
Professional	0.0	0.9	0.6	4.2	15.3	37.8	3.9
Administration	1.5	3.7	2.6	5.3	8.4	14.2	3.8
Clerical	0.4	2.8	2.6	13.7	35.3	30.7	7.7
Sales	7.1	13.9	10.2	16.1	10.8	5.5	10.3
Agricultural	65.4	44.9	51.2	26.4	9.3	2.3	43.4
Production	21.8	26.9	29.0	27.4	14.1	3.9	25.0
Service	3.7	7.4	3.9	7.0	6.8	5.5	4.6
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1975							
Professional	0.0	0.7	0.6	1.8	10.0	38.5	4.4
Administration	0.3	0.7	1.7	2.0	3.6	11.7	2.4
Clerical	0.0	1.4	1.9	7.1	24.5	29.8	7.5
Sales	11.6	14.5	13.5	15.1	16.0	7.3	13.6
Agricultural	56.0	42.4	32.5	19.5	7.9	1.8	27.3
Production	27.0	31.2	45.4	49.3	33.1	8.3	39.9
Service	5.1	8.7	4.4	5.3	4.9	3.4	4.8
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1988							
Professional	0.0		0.5	0.9	4.7	31.1	6.4
Administration	0.0		0.4	0.5	1.4	4.9	1.4
Clerical	1.0		3.9	5.7	17.2	29.5	11.6
Sales	9.1		11.6	12.5	18.7	16.6	14.3
Agricultural	50.7		26.6	12.5	6.3	1.6	15.3
Production	29.7		49.1	60.7	43.7	12.0	43.7
Service	8.6		7.9	7.3	8.1	4.3	7.3
Total (%)	100.0		100.0	100.0	100.0	100.0	100.0
Total (000)	209.0		1636.0	1099.0	1328.0	772.0	--
1993							
Professional	0.0		0.1	0.2	0.9	22.8	6.4
Administration	0.7		3.6	4.2	7.8	15.0	1.4
Tech. & Assistant	0.7		1.9	4.0	18.9	34.6	11.6
Clerical	0.0		1.0	2.0	6.4	7.5	14.3
Service & Sales	11.0		13.0	12.6	15.2	8.6	15.3
Agricultural	53.7		26.8	12.5	6.0	1.6	43.7
Production	33.8		53.6	64.6	44.7	10.0	7.3
Total (%)	100.0		100.0	100.0	100.0	100.0	100.0
Total (000)	136.0		1357.0	1232.0	1658.0	1039.0	--
1997							
Professional	1.0		2.8	3.8	6.7	11.9	6.4
Administration	0.0		0.1	0.1	0.4	20.7	5.1
Clerical	2.0		2.5	4.4	17.7	37.1	16.1
Sales	1.0		0.8	1.4	5.7	7.1	4.0
Agricultural	9.0		12.5	13.4	15.3	9.8	12.9
Production	56.0		26.6	11.0	5.4	1.5	10.8
Service	31.0		54.7	66.0	48.7	12.0	44.7
Total (%)	100.0		100.0	100.0	100.0	100.0	100.0
2000							
Professional	0.0		0.1	0.1	0.4	19.8	5.4
Administration	1		3	3	5	12	6.2
Tech. & Assistant	0.0		2.1	3.7	16.6	37.5	16.7
Clerical	0.0		0.8	1.5	5.2	7.3	4.2
Service & Sales	11.0		14.3	14.7	16.9	9.1	13.9
Agricultural	58.9		27.9	10.1	4.6	0.8	9.3
Production	27.4		51.8	67.0	50.7	13.3	44.3
Total (%)	100.0		100.0	100.0	100.0	100.0	100.0
Total (000)	73.0		914.0	1241.0	1953.0	1490.0	--

Source : See Table 4

Table 7 Distribution of Employment by Occupation within Educational Groups, Females, 1965-2000 Unit: %

Occupational Group	Educational attainment						Total (%)
	Illiterate	Self-taught	Primary school	Junior high school	Senior & Voc. High	College and above	
1965							
Professional	0.0	0.0	0.8	12.9	47.0	62.5	5.4
Administration	0.9	0.0	1.2	1.4	0.0	0.0	1.0
Clerical	0.3	0.0	1.6	20.0	42.4	37.5	5.7
Sales	10.7	15.0	11.6	17.1	4.5	0.0	11.1
Agricultural	69.6	65.0	48.3	12.9	0.0	0.0	49.4
Production	9.9	10.0	26.3	28.6	6.1	0.0	18.9
Service	8.4	10.0	10.2	7.1	0.0	0.0	8.5
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1975							
Professional	0.0	0.0	0.6	3.2	12.7	53.6	4.5
Administration	0.0	0.0	0.3	0.9	2.7	1.4	0.6
Clerical	0.3	0.2	1.7	12.5	52.3	39.1	10.7
Sales	13.6	13.6	14.5	13.9	8.2	2.9	12.9
Agricultural	64.7	72.7	30.2	11.6	4.1	1.4	32.3
Production	15.5	9.1	43.7	50.9	15.9	1.4	32.0
Service	5.9	4.5	9.1	6.9	4.1	0.0	7.0
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1988							
Professional	0.0		0.3	0.6	6.6	39.1	7.6
Administration	0.0		0.1	0.2	0.2	0.5	0.2
Clerical	0.3		2.6	7.3	40.7	47.2	20.9
Sales	13.2		17.2	14.0	15.3	7.6	14.4
Agricultural	44.4		17.7	4.3	1.4	0.0	10.7
Production	29.5		45.8	59.3	26.6	2.6	34.7
Service	11.9		16.2	14.6	9.2	2.6	11.5
Total (%)	100.0		100.0	100.0	100.0	100.0	100.0
Total (000)	295.0		908.0	508.0	931.0	422.0	--
1993							
Professional	0.0		0.1	0.2	3.7	29.9	6.9
Administration	0.0		0.8	1.4	1.7	3.2	1.6
Tech. & Assistant	0.0		1.3	4.3	20.3	34.6	14.6
Clerical	0.0		2.3	7.9	31.6	24.7	17.5
Service & Sales	20.3		27.7	31.3	21.9	4.8	21.6
Agricultural	46.4		18.1	5.4	1.7	0.3	8.7
Production	32.8		49.6	49.5	19.1	2.1	29.1
Total (%)	100.0		100.0	100.0	100.0	100.0	100.0
Total (000)	192.0		830.0	517.0	1165.0	619.0	--
1997							
Professional	0.0		0.7	1.1	1.6	3.5	1.7
Administration	0.0		0.1	0.2	3.6	26.1	7.8
Clerical	0.0		1.1	4.3	16.9	33.6	15.3
Sales	0.0		3.7	8.1	30.9	27.7	19.9
Agricultural	20.5		29.8	33.9	26.6	6.4	23.1
Production	47.3		17.5	5.0	1.1	0.2	6.7
Service	32.2		47.1	47.4	19.3	2.5	25.6
Total (%)	100.0		100.0	100.0	100.0	100.0	100.0
2000							
Professional	0.0		0.0	0.0	2.4	24.4	8.0
Administration	0		1	1	1	3	1.5
Tech. & Assistant	0.0		1.1	3.1	16.7	34.4	16.8
Clerical	0.0		2.8	7.4	29.4	28.1	20.6
Service & Sales	23.6		32.3	36.7	28.9	7.2	24.2
Agricultural	45.3		16.8	5.4	1.1	0.2	5.3
Production	30.2		46.2	46.6	20.1	2.8	23.5
Total (%)	100.0		100.0	100.0	100.0	100.0	100.0
Total (000)	106.0		632.0	556.0	1423.0	1106.0	--



Source : See Table 4

III. Taiwan's Current Human Resource Development Problems

Although the mechanisms for human resource development were sufficient to meet the rising demand for human resources at the various stages of Taiwan's economic development, however, these same mechanisms are now inadequate in meeting the needs of Taiwan's human resources as the country prepares itself to enter the stage of KBE. These deficiencies are apparent in a number of areas, including:

1. *A decline in the quality of the higher education.* During the last several years although the number of college students rise very rapidly, the quality of college education has been declining. This is partly due to the inability of the educational budget to increase at the same rate of the number of students and partly due to the lack of qualified professors to meet the rapid expansion in the number of colleges and universities. For example in 1976 the student teacher ratio for the public university was 9.85 persons, it declined to 9.61 in 1981, but since then it was on the rise, to 11.17 persons in 1996, 13.18 in 1999 and 13.92 in 2000. For private colleges and universities the picture is even worse. In 1976 the student teacher ratio was 18.56 and it never dropped it just continuously increase to 19.81 in 1981 and 21.29 in 1996, 24.82 in 1999 and 24.86 in 2000.(Ministry of Education 2002)
2. *The shortage of qualified personnel in the key areas.* There is an abiding need to attract specialists in many fields, including the important areas of project management and the management of large scale of science research projects.
3. *The increasing gap between the actual and required curriculum.* Many of those in academia capable of achieving college professor positions, have never held jobs in the major industries, therefore, there is a growing gap between what is taught in classrooms of colleges and universities, and what is actually needed by industry.
4. *The inability to attract high-level overseas Chinese professionals to return to Taiwan.* For many years, there have been a large number of Taiwanese students studying abroad, particularly in the United States and Canada. Many of these, who are now well qualified scientists working in the United States, are urgently needed by industries and research institutes in Taiwan. However, Taiwan is currently unable to induce these people to leave their current positions and take up similar positions back in Taiwan, partly due to the chaotic political environment in Taiwan and partly due to the rapidly economic development in Mainland China where the potential of personal development is much larger there.
5. *The lack of encouragement for creative work.* The current HRD system is unable to train people and induce the levels of creativity that are urgently needed in Taiwan's pursuit of a KBE.
6. *Lack of interdisciplinary studies and joint research.* Currently it is due to Taiwan's government budgeting system that it discourages scholars to engaging interdisciplinary studies and joint research projects. Thus new breakthrough in research work is difficult to achieve.

7. *The lack of economies of scale.* Most of Taiwan's colleges and universities are too small and hence, are unable to achieve economies of scale. There are only nine universities in Taiwan today that can boast a student body in excess of 15,000.

In order to dispose of these deficiencies, the Ministry of Education recently announced a number of countering policies, as follows:

1. *Raising the number and quality of researchers.* The government has announced that over the next four years it intends to raise the ratio of college-trained research fellows within the population to 360 per 100,000 persons. The government has also announced its intention of increasing the proportion of research fellows with at least an MA degree to 60 percent. Over a ten-year period, the government aims to increase the college-trained research fellows to 450 per 100,000 persons, with 65 percent of all research fellows with at least a master's degree.
2. *Enhancing science and technology education.* This will involve encouraging college students to engage in interdisciplinary studies in order to widen academic knowledge, and research fellows to engage in interdisciplinary research in order to benefit industry.
3. *Revising the current income tax system for the purpose of encouraging lifelong studies.* . There is a proposed bill in the Executive Yuan where its purpose is to remove recurrent and lifelong educational expenses from taxable income.
4. *Boosting part-time and recurrent education opportunities.* The government aims to encourage colleges and universities to offer special programs, which will eventually lead to a college degree or a certificate, for part-time students studying during evenings and at weekends. Thus full-time employees can gain access to continuing education.
5. *Improving foreign language capabilities.* By boosting the language abilities of college students, faculty members and research fellows, thus cooperation in large-scale international research will be possible. Several universities have in fact recently announced that students must meet a certain level of proficiency in English before they can receive their BA or MA degree. Other universities are demanding greater internationalization of each department's curriculum, through a certain proportion of their courses being offered in English. Again, the purpose is to promote international cooperation in the fields of teaching and research.
6. *The encouragement of exchange research.* The government wants to encourage cooperation between research fellows and teaching staff in universities and businesses, in an attempt to bridge the knowledge gap between industry and academic institutions.
7. *The encouragement of computer networking and e-learning in primary and secondary schools.*
8. *The promotion of distance learning in colleges and universities.*

9. *The encouragement of creativity in college teaching.*
10. *The promotion of world-class universities and research facilities.*
11. *The establishment of interdisciplinary research centers as a means of promoting interdisciplinary learning and research.*
12. *The establishment of mechanisms to facilitate more rapid and effective dissemination of research results from universities to industry.*
13. *The promotion and strengthening of intellectual property rights protection.*

IV. A New Paradigm in Human Resource Development

The Changing Roles of Educational Institutions and the Government

A knowledge-based economy requires a workforce that is characterized not only by a large proportion having attained higher level of education, but workers also must be innovative and creative. The fundamental philosophy of college education must therefore shift from an emphasis on educating the elite, to educating the masses; in other words, instead of concentrating on those students with the ability to reach the very top, colleges and universities must aim to reach the majority of the population, whilst also striving to encourage these students to be innovative and creative, thus cultivating the ability to survive in a KBE. Clearly, therefore, if Taiwan is to accomplish this task, the current human resource development and higher education paradigm must be transformed completely. Rather than providing students with a certain level of skills and knowledge, the new paradigm for HRD must be to change the attitude of students and employees from being passive learners and passive human capital accumulators, to active human capital investors.

The concept of ‘human capital’ was first introduced in 1961 at the University of Chicago by Professor Theodore W. Schultz. At that time, the amount of human capital possessed by a person was equated to that person’s years of formal education (Schultz 1961). Later on, other theorists added on-the-job training, informal learning, language ability, personal traits and a variety of other facets to the factors influencing a person’s human capital (Becker 1993). For the purpose of our discussion here, we list the factors influencing a person’s human capital as:

$$HC = [(K, S, Ta) + B] \times E \times T \quad (1)$$

Where HC refers to human capital; K represents knowledge; S stands for skill; Ta is the talent of a person; B refers to behavior; E represents effort; and T stands for time.

We know that in equation (1), a person’s human capital is determined by the amount of knowledge, skills and talent that he possesses; however, an important consideration is that even if he has a great deal of knowledge, skills and talent, if he fails to apply effort into the appropriate utilization of these assets, then he has no human capital, just as in the case of any uneducated or untrained person. In order to increase a person’s human capital, we have to encourage a particular type of appropriate behavior. If we can imagine for a moment, a high

school teacher dressing and behaving like a nightclub singer, then might not be employed by a school, despite the fact that he is indeed a very knowledgeable and talented teacher.

Since in a knowledge-based economy, we must constantly update our knowledge, skills and abilities in order to remain creative and innovative in the ever-changing world, it is impossible for anyone to design a program that can be described as best suiting any particular person, or indeed, groups of people. An individual must establish what type of work he wishes to engage in, and whether he has the talent that will enable him to achieve this particular career goal. He must then establish what type of knowledge, skills and behavior are needed in order to enhance his specific human capital. He himself must put in the time and effort to acquire the knowledge, skills and appropriate behavior, and then learn to apply this acquired human capital to his job.

In short, in a knowledge-based economy, all students and employees must change from being passive learners, waiting for teachers or employers to guide them towards relevant learning, and to demonstrate how they must learn, to become active human capital investors. They must actively search for the appropriate types of knowledge, skills and behavior that are required for them to perform well and effectively at their specific job.

Given these conditions, what are the current, appropriate functions of both the government and educational institutes in guiding future human resource development? The appropriate functions of the government and educational institutes, and of the teachers within such institutes, are no longer concerned with basic curriculum planning and with the transference of knowledge and skills to students. Rather, they must now serve as facilitators, creating and providing the most favorable environment for human capital investment. Indeed, the new functions of colleges, universities and the government include a number of specific areas, as follows:

Suppliers of Information on People's Talent

In a KBE, there is a growing need for diversified knowledge workers; thus college training also has to be diversified. In order to develop diversified knowledge workers, a college or university must therefore change its admissions policy, no longer concentrating on standardized entrance examinations where every applicant must compete on the basis of IQ, mathematics, literature and scientific knowledge. The admission function should in future concentrate on determining the special and specific talents of its individual applicants and then direct them into the most appropriate field of study where they can develop their human capital to the full. For example, the core competences required in accounting are very different from those in the fine arts, and the core competences required for mechanical engineers are very different from those required of people engaging in social work. Even in the same discipline, e.g., economics, the core competences as a college professor are very different from pure research fellows.

Thus it is the function of universities to undertake research effort into determining the core competences required of different fields and then to come up with appropriate tests to seek out the talents of a diverse range of applicants. The admissions offices of universities will therefore need to be staffed with well-qualified career counselors who have the ability to guide applicants and students into their most appropriate field of study, and who can also provide these applicants with the help that they need to design their most appropriate

combination of courses. With this sort of support, college students will be able to achieve the highest returns on their human capital investment, both their time and their financial outlay.

It is for this very reason that the Ministry of Education in Taiwan has now abolished the 50- year old general college admissions examination, where every single high school graduate was formerly required to sit exactly the same examination, on the same day, and was then allocated to an ‘appropriate’ school and field of study. There are untold numbers of cases where students have been allocated to a certain university and field of study which have been in direct contradiction to their fields of interest.

Today, every university is allowed to admit students in two different ways, the first of which is referred to as ‘selection admission’ where applicants provide their scholastic achievement scores, application forms, study plans and documents supporting other activities that are deemed to add to their qualifications. Each department then forms a committee to screen all applications, with all applicants who successfully pass the screening process being invited to interview. Those applicants passing the interview are subsequently accepted for their chosen field of study at the university. The second avenue is for a student to sit an examination, which is administrated by the Ministry of Education, the results of which are subsequently provided to the student. The student then submits these results to different schools and lets the demand and supply within each school, and the particular field of study, determine whether the student will be successful in gaining admission to the school of his choice.

Different Universities Providing Diversified Areas of Specialization

As opposed to each college and university attempting to play the role of a comprehensive college or university providing the whole gamut of fields of study, in accordance with its specific location or special resources, each college or university should aim to specialize in different fields so that more students could receive diversified and specialized training. This would be far more pertinent to the industries awaiting the graduation of these students, which can find no use for the type of general training that all colleges and universities are currently providing.

Examples of responses to this kind of inappropriate coverage include the training provided by colleges and universities in the UK, which is much closer to the needs of industry than that provided by Taiwan’s institutions, and yet, research undertaken within the UK also found that industry there spends around 35 million Pounds on further training for these college graduates in order to make them suitably employable for the various industries (Financial Times, 1997, p.14) Furthermore, in order to promote the KBE in Finland, the country has reformed its higher education policy in recent years, doubling university enrollment capacity and also creating a different types of non-academic training higher education establishment, a new form of higher education which places greater emphasis on technical training (OECD 1996, pp. 4-6). The Ministry of Education in Taiwan is now also encouraging colleges and universities to diversify themselves.

Creating an Environment of High Returns on Human Capital Investment

There are four ways that a country can increase the returns on human capital investment. These are (i) intrinsic satisfaction, such as the challenge of the subject being studied, the

creativity allowed in the field of study and the social relationships built up during the period of study; (ii) opportunities for growth stemming from the field of study; (iii) peer recognition from the results and achievements of the study; and (iv) monetary rewards. University professors and academic institutions nowadays must change their teaching methods and their rewarding systems. They should think of a range of methods of rewarding students which include all of the four types of rewards outlined above, rather than a simple concentration on grade rewards as it has always been in the past.

V. Conclusions

In the stage of economic development when a nation moves towards a KBE, the mission of higher education unavoidably changes from providing education to the elite, to the recognition of the need to provide education to the masses. The admissions policies of colleges and universities must change from seeking out the most talented people, to determining the diverse talents possessed by different students and then guiding them to the most appropriate field of study so that each student may have the opportunity to develop their human capital to the full. This paradigm shift must take place in both vocational education and in other types of education.

It is no longer the role of the government and of training institutions to prescribe the 'right' type of training, but instead, they should concentrate their efforts on establishing a favorable environment so that all people can determine the best way to invest their human capital in such a way that they can receive the highest return on such human capital investment.

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