Application of E-Learning to Pilot Training at TransAsia Airways in Taiwan

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TransAsia Airway is one of the four domestic airlines in Taiwan. Taiwan has 13 domestic airports with the longest distance between two airports being about 400 kilometers. The domestic airline market is highly competitive. TransAsia decided to apply e-learning within its organization to reduce training expenses and improve service quality. This study describes the strategy and methodology used by TransAsia when applying e-learning for regular training, and considers the management changes made by TransAsia when reconstructing its organization behavior and learning culture using e-learning. This study also uses the Krikpatrick model to assess the effect of e-learning within a firm. The TransAsia case is used to provide a reference for the future development of the Taiwanese airline industry.

TransAsia was established in 1951, and has three business departments, namely transportation, shipping, and agent services. TransAsia flies eight

domestic routes and four international routes. TransAsia also cooperates with three other airlines in Shanghai, Macao, and Xiamen. TransAsia aims to become the best domestic airline in Taiwan and a renowned airline in the Asia-Pacific region.

The number of passengers traveling by air in Taiwan has recently decreased because of increased gas prices. To increase competition, Porter (1997) recommended that companies should reduce costs and increase the range of services provided. Regular training represents a large proportion of the expenses of an airline. Consequently, to reduce training costs, TransAsia decided in 2004 to replace traditional training with e-learning.

This study describes the strategy employed of TransAsia of applying e-learning to regular pilot training, and assesses the effects of the strategy after one year. The analytical results can provide a valuable reference for other Taiwanese national airlines considering applying e-learning to their organizations. This study has four major goals:

1. create a strategy and process for applying e-learning to organizations (in the Airline Industry);
2. study the effect of e-learning on organizational behavior and learning culture;
3. evaluate learning effects using the model of Kirkpatrick; and
4. identify key success factors from the case study.

Relevant methods, processes and systems for applying e-learning to businesses are outlined before discussing these goals.

Although many researchers and experts have discussed how to apply e-learning to businesses, the "applying strategy" has rarely been mentioned (Horton, 2000; Schank, 2002). Moreover, since numerous works have focused on the Implementation stage of the ADDIE process (Lee & Owens, 2000), this study stresses the Analyze, Design, and Develop parts, while TransAsia applies e-learning using the ADDIE process.

The second goal addresses learning organization and learning culture topics. Robbins (2001) identified five stages of organizational reform:

1. identifying key performance related behaviors;
2. listing fundamental information regarding key behaviors;
3. understanding the results of the major factors;
4. designing and promoting a concrete action plan; and
5. assessing the level of improvement.

Shank (2002) proposed the "freedom" methodology, which involves seven standard criteria, to assess the effects of applying e-learning in an organization. Unlike the freedom methodology, the evaluation model of Kirkpatrick covers not only learner feelings and learning effects, but also

emphasizes how much learners can apply in their routine works and how training methods influence the company (Kirkpatrick, 1959). Therefore, the model of Kirkpatrick was chosen to assess the TransAsia case.

STRATEGY AND PROCESS

Mr. Mike Hsu is a pilot at TransAsia Airway. Mr. Hsu took the training program in his early years as an employee. Mr. Hsu found that senior experienced pilots faced difficulties in passing knowledge on to younger pilots; that is, experienced pilots could not transfer their experience and knowledge to young pilots rapidly and efficiently. Besides those difficulties, the pilot training program also involved many professional lectures dealing with complex issues. Mr. Hsu thus thought that young pilots might gain if the training materials were digitized and localized. Young pilots would then be able to copy the training materials, take them home, and learn them in their own time.

Although Mr. Hsu's idea was implemented and appreciated by young pilots, the strategy was not without its problems. The most significant problem was that the revised training materials could not be delivered to pilots immediately. Meanwhile, the second problem was the lecturers were unable to determine the learning status of young pilots. To solve these two problems, Mr. Hsu participated in the government-backed *National Science and Technology Program* for e-learning. Mr. Hsu realized that e-learning might be not only a solution to his two problems, but also a way of helping TransAsia achieve the following aims:

1. improve pilot training quality and enhance the aviation safety of TransAsia;

2. enhance flight attendant service quality;

3. solve the difficulties in arranging practical training;

4. increase the low learning effectiveness of traditional education;

5. balance flight hours (profits) against training hours (costs); and

6. decrease training costs.

TransAsia has applied a user-centered strategy, based on a step-by-step promotion, which combines work performance and outsourcing. The strategy of TransAsia is presented:

1. The Flight Operation Division (not the Human Resource dept.) initiated the plan and gained strong executive officer support. Moreover, the Information Department and Education and Training Department provided help in information technology and administration operation.

2. The investigation and analytical results indicate that TransAsia divided e-learning courses into different stages based on the course significance and expected benefits. The training personnel were pilots and flight attendants during 2004; operation and business staff in 2005, and maintenance men and administrative staffs in 2006.

3. Related regulations and operational procedures were adjusted, and a reward and punishment system was established.

4. "Blended learning" was used to smooth learning behavior.

5. Experts and consultants were invited to help apply e-learning to TransAsia Airways and analyze the competency of the training personnel.

6. Cooperation was initiated with academia to develop teaching materials and evaluate their efficacy.

Based on the strategy of TransAsia, the ADDIE process was modified and refined as follows:

1. *Analysis:* to analyze e-learning requirements and readiness, ensure that the learning goals are achieved, and then decide whether to apply e-learning in the same manner as TransAsia.

2. *Design:* to design an action plan and checklist, build a method of efficacy evaluation and key performance indicators (KPIs), construct a system of rewards and punishments, and perform instruction design.

3. *Development:* to create a project promotion group, establish a project schedule and check points, select the software and hardware specifications, create the annual course list, and train e-learning lecturers.

4. *Implementation:* constructing an e-learning infrastructure and learning management system involves establishing a staff training environment, course design, and creating learning quality control.

5. *Evaluation:* to interview the department managers, survey learner satisfaction, and discover changes in working performance.

As mentioned, this study focuses on three stages of ADDIE, namely Analysis, Design, and Development. The evaluation stage is discussed in the Evaluated Learning Effectiveness Section.

Analysis Stage

The analysis stage involves two main tasks. The first task is to analyze the current training situation and problems in TransAsia. Meanwhile, the second task is to establish the e-learning readiness survey. For the first item, Table 1 lists the training program of TransAsia airways provided during 2003. In applying its training program, TransAsia encountered the following problems:

1. training courses are difficult to schedule because of the different flight hours of different pilots;

Table 1
TransAsia Training Program in 2003

UNITS	Courses	Course Hours	How Many Trainees
Flight Operation Division	43	2348	1012
In-Flight Service Department	6	70	292
Business Affair Department	41	3561	421
Maintenance & Engineering Division	23	456	512
Resources Management Department	30	544	414
TOTAL	**143**	**6979**	**2660**

2. learners need to follow the speed set by the teacher, and do not have enough time to ask questions;

3. knowledge cannot be transferred rapidly or efficiently;

4. learning effects are difficult to understand;

5. learning is constrained by time and space, and

6. training costs are high.

To resolve the second problem, a questionnaire was designed to understand the e-learning readiness of individual departments and determine their priorities. Cross and Dublin (2002) believed that a successful e-learning applicant should comply with three following keys: Readiness, Willingness, and Ability. Thus the questionnaire items include:

1. Can the learner use a computer and surf the Internet?

2. Does the learner have a basic understanding of e-learning?

3. Does the department have sufficient hardware and software for promoting e-learning?

4. Do the course designers and lecturers understand e-learning, and are they willing use it?

5. Do related departments understand e-learning, and are they willing to support it?

6. Do executive officers strongly support e-learning?

Design Stage

The design stage also comprises two parts. The first stage involves setting priorities for applying e-learning in individual departments and divisions. Meanwhile, the second stage involves establishing an efficacy evaluation report and KPIs (key performance indicators).

Table 2 shows that the Flight Operation Division and In-Flight Service Department have the highest priority using e-learning in 2004. The priority is determined based on how much extra benefit could be gained after applying e-learning, and the cost of building e-learning courses. The Business Affairs Department applied e-learning in 2005. E-learning was first arranged for the Maintenance and Engineering Division and the Resource Management Department in 2006, since it was difficult to produce e-learning materials for these two departments.

After setting the priority of applying e-learning for each department, TransAsia assigned expected outcomes for the 10 KPIs, including number of trainees, number of courses, number of course hours, learner learning satisfaction, e-learning material satisfaction, assistant satisfaction, administration satisfaction, platform satisfaction, LOMS and number of pilots retrained. TransAsia designed a questionnaire for measuring those satisfaction KPIs, and the answers on the questionnaire were measured using a 5-point Likert scale, and included: strongly agree (SA), agree (A), neutral (N), disagree (DA), and strongly disagree (SDA). Table 3 shows the expectations of TransAsia regarding KPIs. Moreover, the Line Operation Monitor System (LOMS) in Flight Operations Quality Assurance (FOQA) was applied to

Table 2
E-Learning Readiness Survey

ITEM UNITS	Learning Efficacy	Extensible Efficacy	M	R	MS	e-Materials	Difficulty of Developing Materials	Learning Device	TOTAL
Flight Operation Division	5	5	5	4	5	4	3	4	35
In-Flight Service Department	4	5	5	3	5	1	5	4	33
Business Affair Department	4	5	4	4	5	2	2	4	30
Maintenance & Engineering Division	5	5	4	3	5	1	3	3	29
Resources Management Department	4	2	4	4	5	1	2	4	26

*M – Motivation   *R – Readiness   *MS – Manager Support

Table 3
Expectations of TransAsia Regarding KPIs

Item	Trainee Number	Courses	Course Hours	LS	MS	AS	AdmS	PS	LOMS	D
RESULT	1500	30 (self-made)	75 hrs (self-made)	>4.0	>4.0	>4.0	>4.0	>4.0	Airbus <0.10	0
		24 (outsourcing)	4.25 hrs (outsourcing)						ATR <0.15	

*LS – Learning Satisfaction
*MS – e-learning Materials Satisfaction
*AS – Assistant Satisfaction
*AdmS – Administration Satisfaction
*PS – Platform Satisfaction
*LOMS – Line Operation Monitor System in Flight Operations Quality Assurance
*D – Disqualification Number

assess the change in the learning behavior of individual pilots. Besides LOMS, TransAsia also treated the pilot retraining result as a KPI, because pilot retraining requires significant business resources. Table 3 presents the expectations of TransAsia regarding the ten KPIs.

Development Stage

TransAsia organized e-learning promotion groups (Table 4). Five organizations, namely the Project Committee, Advisory Committee, Flight Operation Division, Resource Management Department, and Information Center, participated in these promotional groups. Each organization was involved in one or more task force groups, and each task force group specific responsibilities (Table 4).

SHAPED ORGANIZATIONAL BEHAVIOR AND LEARNING CULTURE

Mr. Hsu designed concrete action plans for each of the four directions for reforming organization proposed by Robbins in 2001:

1. Positive Reinforcement
   a. To provide trainee assistance and technical training to make trainees into capable e-learners.
   b. To deliver flight schedule and announcement through the e-learning website rather than using conventional methods.
   c. To post all manuals, including those published by the airline on the e-learning website, and to enable the relevant personnel to read online without constraints of time and space.

Table 4

Architecture of e-Learning Project Promotion Groups

Organization	Task Force	Work Description
Project Committee	Promotion Group	• deciding company e-learning policy, resource distribution, and cross-department cooperation
Advisory Committee	Consultant Group	• consulting the e-learning application proces • consulting the computer technology and learning platform • consulting the material development • consulting course operation
Flight Operation Division	Course Operation Group	• planning how to apply training courses and make recommendations and evaluations based on the actual situation
	Lecturers Group	• educating e-learning lecturers selected from employees and developing e-learning materials
	e-Tutor Group	• assisting lecturers, encouraging learners, solving simple questions for learners, and maintaining material content
	IT Seed Group	• teaching learners basic computer skills and solving computer and Internet problems faced by learners
	Promotion Activities Group	• holding e-learning promotion activities and developing a system of rewards and punishments
Resource Management Department	Budget Control Group	• doing budget control
	Training Resource Group	• devising e-learning strategy, goals, and related management regulations
Information Center	System Maintenance Group	• maintaining hardware, software, network, and systems

       d. Ten percent (10%) of personnel belonged to flight crews, but their training budget comprised 70% of the total company training budget. Furthermore, 60% of the flight crew training budget went on simulation training. TransAsia thus asked trainees to study by way of e-learning regardless of constraints of time and space.

  2. Negative Reinforcement

      a. To apply the training board to the e-learning website to improve knowledge control for flight crew members.

      b. To perform online tests to ensure that all flight crew members understand aviation safety information and flight knowledge.

3. Punishment

All crew members are required to study a designated course online, and to take an online test before the due date. The items are randomly selected from the item bank, and the answering time is limited to 30 seconds to prevent cheating. The pass mark is 80 (out of 100). A flight crew member who fails or does not take the online test must take the test at the TransAsia training center. Members who still cannot pass the test face cancellation of their flight permits and a likely salary reduction.

4. Extinction

Strong support and promotion activities from executive officers are required to reduce opposition.

TransAsia used the learning culture proposed by Rosenberg in 2001, which is similar to reforming organization behavior, when developing the new learning culture. TransAsia employed seven actions to develop e-learning into a bridge between working and learning:

1. Each employee course list was added to the daily task list of the manager. Managers were required to meet employees before and after important courses, to help them apply newly learned knowledge and skills to their daily jobs.

2. Employees were encouraged to spend time to access company news and important information through the e-learning website, and to share this knowledge with each other by way of the website discussion forum.

3. A reward system was built for employees who were willing to share knowledge and expertise with others.

4. Courses were planned carefully, and certificates were given to learners upon completion of courses, because such certificates made learners feel they had achieved something.

5. Executive officers and/or senior employees were trained as lecturers to enable them to share their valuable experiences and knowledge.

6. E-learning was used to establish an equal learning opportunity environment for all users.

7. An efficient learning channel was established to enable learning without constraints of time or space.

The e-learning platform records demonstrate that most pilots and flight crews used the platform during the times 10–12 AM, and 03–06 PM, showing that most trainees learned in the dormitory during their standby time. New learning cultures were born in TransAsia airlines.

ASSESSING LEARNING EFFECTIVENESS

TransAsia applied the four levels of Kirkpatrick, namely reaction, learning, behavior, and result, to understand trainee satisfaction and the influences on business. Table 5 shows the relation between the four levels and KPIs.

Reaction level measures trainee satisfaction with the learning process. TransAsia sent 90 questionnaires to trainees who had completed the e-learning course. Sixty questionnaires were gathered with one invalid response, representing a return rate of 66%. The questionnaire answers were measured by a 5-point Likert scale, including: strongly agree (SA), agree (A), neutral (N), disagree (DA), and strongly disagree (SDA). Table 6 lists average trainee satisfaction, and reveals that almost all satisfaction KPIs reached 4.0 (Agree).

Tables 7–9 show pilot satisfaction according to their positions (Table 7), flying hours (Table 8), and working years (Table 9). Table 7 indicates that copilots have higher average satisfaction than pilots, and pilots have higher average satisfaction than coaches. These results are not unexpected because copilots require learning courses to pass regular exams and achieve promo-

Table 5

Relation Between the Kirkpatrick Four Levels and TransAsia KPIs

Level	KPI
Reaction	Learning Satisfaction Satisfaction with e-learning materials
Learning	Learning Effects
Behavior	LOMS Disqualification Number
Result	Cost and Efficacy

Table 6

Trainee Satisfaction

KPIs	Factors	Avg	Standard Deviation
Learning Satisfaction	Interaction	3.63	0.63
	Expectation	3.97	0.59
	Convenience	3.91	0.57
	Approval	4.04	0.54
e-learning Materials Satisfaction	Course design	3.77	0.64
	UI design	3.68	0.58

tion. However, the results listed in Table 8 (flying hours) are especially interesting, since they demonstrate that the highest satisfaction was achieved by two groups, those with 0–2,999 flying hours and those with over 15,000 flying hours. The trend of average satisfaction thus resembled a valley, with the lowest satisfaction being found in the 9,000–11,999 flying hours group. The reason for this observation still remains to be determined. Table 9 also confirms the discovery from Table 7, that the average satisfaction of the group with 1–5 yrs. of experience exceeded that of the group with 6–10 yrs. of experience, which in turn exceeded the group with 11–15 yrs. experience. Notably, the interaction satisfaction in the group with 1–5 yrs. experience was lower than in the group with 6–10 yrs. experience, possibly owing to different levels of experience using the Internet. Younger pilots possessed more computer and Internet surfing experiences than older pilots.

The second level in the model of Kirkpatrick assesses the effects trainee learning. TransAsia has applied e-learning since February 2004. The disqualification rate (recruit training, retraining, promotion training) remained high, reaching 10% in April, but reduced to 2.45% in May and then continued to gradually decrease. The reason for the increase in disqualification rates during the first three months was learner unfamiliarity with the e-learning mode. After learners adapted the new learning method, disqualification rates decreased and learning effects began to emerge.

Behavior level was adopted to verify the ability of trainees to apply learned knowledge and skills to their routine work. TransAsia used the LOMS in FOQA for behavior level evaluation. The data showed on the indicators of case numbers reduced to 0.08 (Airbus) and 0.10 (ATR) after the application of e-learning, indicating a continued increase in the aviation safe-

Table 7
Pilot Satisfaction (by positions)

KPIs	Factors	Average			F value
		Copilot (29)	Pilot (27)	Coacher (3)	
Learning Satisfaction	Interaction	**3.97**	3.62	3.51	3.55**
	Expectation	**4.00**	**3.97**	3.81	0.45
	Convenience	**3.91**	**3.87**	**3.85**	3.15**
	Approval	**4.03**	**4.07**	3.91	2.51*
e-learning Materials Satisfaction	Course design	**4.04**	**3.89**	**3.85**	0.57
	UI design	**3.81**	3.74	3.51	3.02**
* : $p < 0.1$ ** : $p < 0.05$ *** : $p < 0.01$					

Table 8
Pilot Satisfaction (by flying hours)

KPIs	Factors	Average						*F* value
		0-2,999 (3)	3,000-5,999 (5)	6,000-8,999 (17)	9,000-11,999 (26)	12,000-14,999 (6)	>15K hours (2)	
Learning Satisfaction	Interaction	**4.03**	3.62	**3.96**	3.48	3.10	**3.90**	2.72**
	Expectation	**4.67**	4.00	3.99	3.93	3.46	**4.75**	2.81**
	Convenience	**4.27**	3.88	3.94	3.72	**4.23**	**4.80**	2.48**
	Approval	**4.67**	3.85	4.21	3.78	**4.21**	**5.00**	5.29***
e-learning Materials Satisfaction	Course design	**4.50**	4.07	3.97	3.88	3.44	**4.33**	1.90
	UI design	**4.56**	**4.56**	3.88	3.54	3.94	**4.33**	1.64

* : $p < 0.1$ ** : $p < 0.05$ *** : $p < 0.01$

Table 9
Pilot Satisfaction (by working years)

KPIs	Factors	Average			*F* value
		1-5 yrs. (4)	6-10 yrs.(19)	11-15 yrs. (36)	
Learning Satisfaction	Interaction	**3.88**	**3.93**	3.45	4.24**
	Expectation	**4.69**	3.99	3.88	3.61**
	Convenience	**4.20**	**4.16**	3.75	4.10**
	Approval	**4.63**	4.01	3.99	2.71*
e-learning Materials Satisfaction	Course design	**4.46**	3.99	3.83	2.48*
	UI design	**4.33**	3.84	3.69	1.42

* : $p < 0.1$ ** : $p < 0.05$ *** : $p < 0.01$

ty of TransAsia. Before 2004 (e-learning), two pilots were suspended from flying and required to take retraining, but after applying e-learning, no pilot was suspended from flying, and no pilots required retraining (Table 10).

Organization performance was then measured. Opportunity Cost was used to assess the organizational performance of TransAsia after e-learning was applied to the organization (Table 11).

Table 10
TransAsia Expectations and Results (KPIs)

Item	Trainee Number	Courses	Course Hours	LS	MS	AS	AdmS	PS	LOMS	D
EXPECT	1500	30 (self-made) 24 (outsourcing)	75 hrs. (self-made) 4.25 hrs. (outsourcing)	>4.0	>4.0	>4.0	>4.0	>4.0	Airbus <0.10 ATR <0.15	0
RESULT	1500	**36** (self-made) 24 (outsourcing)	**80** hrs. (self-made 4.5 hrs. (outsourcing)	**4.15**	**4.55**	**4.05**	**4.15**	**4.1**	Airbus **0.08** ATR **0.10**	0

*LS – Learning Satisfaction
*MS – e-learning Materials Satisfaction
*AS – Assistant Satisfaction
*AdmS – Administration Satisfaction
*PS – Platform Satisfaction
*LOMS – Line Operation Monitor System in Flight Operations Quality Assurance
*D – Disqualification Number

Table 11
Organization Performance Versus Opportunity Cost

Item	Opportunity Cost
Flight Crew Salary	Save approximately 340 thousand USD (save training time, increase flying time)
Operating Earnings	Save approximately 840 thousand USD (ability to schedule additional flights)
Lecturer Expenses	Save approximately 20 thousand USD (savings on salaries for lecturers)
e-learning Expenses	Spend approximately 400 thousand USD (course development, infrastructure construction, learning management system, e-learning websites, and so on)
Total Opportunity Cost	**Save approximately 800 thousand USD/yr**

CONTENT OF E-LEARNING TRAINING COURSE

TransAsia has developed 60 e-learning courses, including 36 courses (in total: lasting about 80 hours) produced in-house. The Flight Operation Division has developed 30 courses, and the In-Flight Service Department has developed six courses. Sixteen courses deal with basic theory; 11 courses

deal with operating sequence, seven involve navigation, and two involve laws and regulations. TransAsia implemented the e-learning courses using Microsoft Producer for Powerpoint 2003. The remaining 24 courses were outsourced, and course topics included simulation and learning object case study. These outsourcing courses were produced with Macromedia Flash.

The two snapshots were chosen to describe the simulation learning object. Figure 1 illustrates the force of airplane engine by reacting force based on the third motion law of Newton. It is difficult to teach airline engine operation in a class. The second case shows when of two planes flying across the paths of one another for teaching flight (Figure 2) This situation requires the pilot to manage communication and judgment. This case can easily be simulated using e-learning materials.

To achieve high learner satisfaction, several critical success factors should be considered:

1. The learning contents must include working knowledge and skills, and the teaching materials must match the daily routine of employees.

2. Effective work groups should be formed. TransAsia brought all three of its units together to help in developing material. TransAsia performed project management and invited experts on subject matter (SME); Tamkang University designed instructional materials, planed the development procedure, and assessed the entire process, and Sun NET conducted media design, technology support, and consultancy.

3. Learners need to be highly qualified. Learners are familiar with web-based environment, and thus can easily learn e-learning content, increasing the efficiency of their learning.

4. Professional and experience expertise is required. TransAsia SMEs have not only rich professional knowledge but also significant work experience. Individual learners consider e-learning content to be very useful.

5. The work flow and assessment procedure must be carefully built up (Table 12). Moreover, the content of the development process must be managed. Consequently, a process and assessment method for e-learning content was designed.

KEY SUCCESS FACTORS

Trainees were issued questionnaires, and managers were interviewed. Six key success factors were identified in the TransAsia case.

1. E-learning promotion was initiated by trainees (also known as learners and users), with strong support from executive officers, and cooperation with other departments.

2. The training mechanism was fully integrated with aviation safety

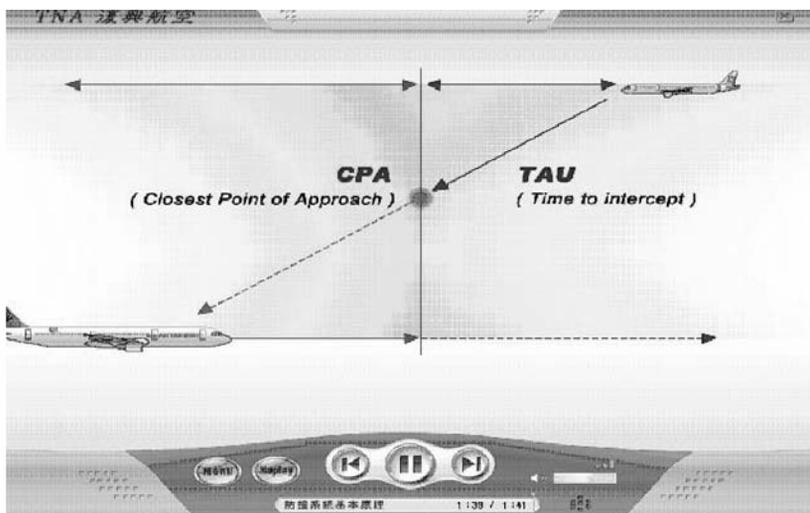**Figure 1.** Shows the turbine engine affecting and reacting force operation

Figure 2. The case when two planes fly to cross each other

issues and working performance. Moreover, the company was required to estimate the opportunity cost.

3. The cross-department e-learning promotion organization (Table 4) enabled cooperation, establishment of new regulations, and systems for reward and punishment.

4. The standard procedures involved in e-learning quality control as performed in academia led TransAsia to develop high-quality learn-

Table 12
E-Learning Teaching Materials Check List

Dimension	Check item
Content	Accuracy Organization and Completeness Clarity and Appropriateness
Navigation	Navigation Guideline Online-Help Operation Support Keeping Track of Learner records
Instructional Design	Instructional Objectives Teaching Presentation and Demonstration Practice and Feedback Testing and Assessment Engagement Learner Strategy Motivation Learner Strategy Consistency
Instructional Media	Media Design and Implementation Interface Design Media Object

ing courses, enabling trainees to learn rapidly and efficiently.

5. The reward system attracted employees to become lecturers, and thus share their knowledge and experience with others.

6. Governmental incentives for businesses applying e-learning to their organization also accelerated the decision process of TransAsia. The government reward was provided by the Ministry of Economics Affair subprogram, part of the National Science and Technology Program for e-learning in Taiwan.

CONCLUSIONS

According to the KPIs and the four levels of Kirkpatrick, the TransAsia case study can be summarized as follows.

1. *Learning satisfaction:* flight crews provided highly positive opinions, indicating that TransAsia would benefit from continuously promoting e-learning.

2. *E-learning Material Satisfaction:* flight crews believed that the course materials were suitable for learning.

3. Different background pilots recorded different levels of satisfaction with the Learning Satisfaction and e-learning Material Satisfaction questionnaires.

4. *Learning level*: the average disqualification rate reduced to 5%, showing that trainee learning met expectations.

5. *Behavior level:* the LOMS demonstrated that TransAsia improved its level of aviation safety.

6. *Result level:* TransAsia gained opportunities worth of approximately US$800,000 per year.

The TransAsia case not only received a government award (valued at approximately $60,000 USD), but was also named a winner (bronze medal) in the Innovative Technology Category in the 2005 Brandon Hall Excellence in Learning Awards.

Future research can consider three issues. The first task is to enhance the e-tutor and e-mentor mechanism to enhance the learning effects and satisfaction. The second task is to implement mobile learning, because mobile devices can help flight crews learn without constraints of time and place. The third task is a research issue, involving the comparison of the Return of Investment (ROI) of TransAsia with other airlines, and of businesses in other industries.

References

Cross, J., & Dublin, L. (2002). *Implementing e-learning*. Alexandria, VA: American Society for Training and Development.

Horton, W. (2000). *Designing web-based training*. Indianapolis, IN: Wiley.

Kirkpatrick, D. L. (1959). Techniques for evaluating training programs. *Training and Development Journal, 13*(11), 3-9.

Lee, W. W., & Owens D. L. (2000) *Mutimedia-based instructional design: Computer-based training, web-based training, distance broadcast training*. New York: John Wiley and Sons.

Porter, M. E. (1997). *Competitive strategy: Techniques for analyzing industries and competitors*. New York: The Free Press.

Robbins, S. P. (2001). *Organizational behavior*. Englewood Cliffs, NJ: Prentice Hall.

Rosenberg, M. J. (2001). *E-learning : Strategies for delivering knowledge in the digital age*. New York: McGraw-Hill.

Schank, R. C. (2002). *Designing world-class e-learning*. New York: McGraw-Hill.

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