

**ADVANCED MANUFACTURING TECHNOLOGIES:  
A PRELIMINARY REPORT OF A COMPARISON AMONG  
AMERICAN, COSTA RICAN AND MEXICAN COMPANIES**

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**Abstract**

This paper presents the preliminary results from an empirical research conducted on AMT implementation and planning practices among American, Costa Rican and Mexican companies. The research was designed to investigate the planning and implementation activities that lead to successful implementation of AMT. It is our purpose to compare the results obtained for different countries on AMT implementation, benefits and investments.

**Keywords**

AMT, information technology, international study, empirical research

## Introduction

In today's economic environment, companies are being forced to change and become more competitive. Global competition as a result of international agreements such as NAFTA is taking companies to adopt new strategies to keep in business. Abernathy et al (1993) mentioned that manufacturing processes are often perceived as barriers to product innovations, not only because of the physical limitation of older equipment, but also because of organizational configurations. Firms that are able to achieve flexibility in their operations can be capable of entering market niches that in the past were neglected because the required capacity did not exist previously. The extensive information capability of AMT allows that information is available at core manufacturing systems in real time. AMT benefits also the design of better decision-making processes, production processes and helps improve the performance of different functions in the enterprise.

Youseff (1992) defines AMT as a group of integrated hardware-based and software-base technology, which if properly implemented, monitored and evaluated, will lead to improving efficiency and effectiveness to the firm in the manufacturing of a product or providing a service. Ehie et al (1995) stated that there are tangible and intangible benefits if AMT is implemented properly; among those benefits, there is inventory cost reductions and improving in manufacturing control. Although AMT can be a strategic weapon, experts believe that 50 to 75 % of these efforts fail to inadequate attention to factor like employee resistance and lack of commitment in the organization (Cleland, Bidande and Chung 1995).

Organizational attitude toward new technology implementation is a key factor in AMT implementation success. In terms of return on investment, the cost of AMT can thus be amortized faster. In terms of implementation, there have been studies conducted to understand the planning and implementation of AMT in a few countries (Mora et al, 1999). Sohal (1991) claims that a small Melbourne-based manufacturer reduced its stock volume by half, providing greater flexibility; set-up times have been reduced to 90 seconds, compared with five to six hours with the old technology. In many of these studies and its results, comparisons are difficult because of the absence of a common instrument. Sohel et al overcome this difficulty conducting surveys in Australia, New Zealand, United Kingdom, and Canada using the same instrument (Sohal et al. 1996).

The instrument that we use in the present study was developed and validated by Sohal. In this paper, we focus on the planning and implementation activities that are conducted by American, Costa Rican and Mexican companies on AMT.

First, we explain the methodology used in the study. Then, the preliminary results for the three countries in study (USA, Costa Rica and Mexico) are presented. And finally, the conclusions based on the preliminary results are shown.

## Research Methodology

The empirical study presented in this paper used a survey instrument developed and validated by Sohal (1996). The sections of the survey used in the following analysis include AMT investment in design, manufacturing and administration, the drivers that encouraged the companies to pursue AMT, the planning and implementation activities for AMT and finally, the performance changes after the implementation of AMT.

The United States sample was obtained by a mailing list similar to Boyer et al (1997). The SIC range of 33 and 37 was used, since they are considered as industries with the most wide use of AMT (Boyer et al, 1997). Data started to be collected in January 1999. In Costa Rica, the sample was obtained by personal contacts and through faculty and staff members of major universities. The collection process started in December 1998. The Mexican data comes from a mailing list provided by the Instituto Tecnológico y de Estudios Superiores de Monterrey. The initiation date for data collection was October 1998. The data collection is still active for all three countries.

## Preliminary results

### AMT Investment

We are interested in measuring the investment made by the companies in various new manufacturing technologies in the last two years. We asked the respondents to answer their company's investments in three areas: design, manufacturing and administration.

In Table 1 we show the results for AMT investments related to design. Computer-Aided Design (CAD) substitutes the traditional paper and pencil with computers to quickly modify and store drawings electronically, even in three dimensions. In all three countries, the majority of the respondents considered a moderate investment in CAD (USA: 100%, Costa Rica: 67.57% and Mexico: 65.06%). Regarding Computer-Aided Engineering, we obtained similar results in the sense that the trend was in investing moderate amounts of money (USA: 64.71%, Costa Rica: 62.16% and Mexico: 64.71%). Finally, moderate investment in Computed-Aided Process Planning is less than the previous two technologies, except for Mexico (71.76% moderate investment). USA obtained 45% as no investment at all and 45% as moderate investment. Costa Rica showed a 55.56% moderate investment in CAPP. It can be drawn that most of the surveyed firms in USA, Costa Rica and Mexico, invest moderately in advanced design technologies.

DESIGN	No Investment			Moderate investment			Heavy Investment		
	USA	CR	MX	USA	CR	MX	USA	CR	MX
CAD	0.00	24.32	21.69	100	67.57	65.06	0.00	8.11	13.25
CAE	23.53	37.84	25.88	64.71	62.16	64.71	11.76	0.00	9.41
CAPP	45.00	33.33	17.65	45.00	55.56	71.76	10.00	11.11	10.59

Table 1. AMT investments in Design.

AMT investment that directly influences the performance of the manufacturing processes was measured. The results are shown in Table 2. Investments in Numerical Control Machines (NC) for the three countries was moderate (USA: 55.56%, Costa Rica: 60.53% and Mexico: 63.41%). Heavy investments are rarely except for American companies (22.22%). Computer-Aided Manufacturing obtained the majority of the results for moderate investment in the case of USA (50%) and Mexico (61.45%). However, Costa Rica shows 47.37% moderate investments and 50% no investments at all. This means that Costa Rican companies are in the way of implementing CAM, but there is still a high percentage of companies that haven't implemented it. Environmental control systems are becoming more important as the standards for

environment become more strict and critical. Since it is kind of recent, it was expected to find very few (or none) companies investing a great amount of money in this control systems. Most of the companies invest moderately in environmental control systems (USA: 70.59%, Costa Rica: 81.08% and Mexico: 92.68%). Bar coding is a technology that helps in improving the time for transactions such as inventory control. Firms are making moderate investments in implementing bar codes in their manufacturing processes (USA: 60%, Costa Rica: 69.23% and Mexico: 75.64%). Time is a competitive weapon in current markets and therefore, manufacturing firms must seek ways of improving timeliness not only in products cycle time but also in information processing. Real time process control systems allow the firms to manage current information and make analysis in real time. This also permits the firms to stop the processes if something goes wrong or to implement corrective actions. USA firms must improve the use of this technology, since 57.89% of the surveyed companies are not investing in real-time process control systems. However, Mexico (80.95%) and Costa Rica (71.79%) are doing moderate investments in this kind of systems. Flexibility, along with timeliness, quality and cost, is a critical component in today's organizations. There are new technologies that enhance the flexibility of the manufacturing processes, called Flexible Manufacturing Systems (FMS). Mexico (70.59%) and USA (65%) are the countries with more moderate investment companies in FMS in our study, and finally, 55.56% of Costa Rican companies are investing moderately in this technology. Materials handling systems have been an issue since effective systems can help in improving time, cost, quality and flexibility. Implementations of Automated Handling Systems in warehouses, distribution centers and production processes are becoming more common in current manufacturing firms. However, in USA, there are still 52.63% of the firms that are not investing in AHS. Mexico has shown interest in this kind of systems, since 59.52% of the firms are in moderate AHS investments and 8.33% are heavy investors of this technology. Group technology (GT) is a technology that has been a success in providing flexibility to the manufacturing processes that require repeatability with low-volume. USA (58.82%) and Costa Rica (61.11%) are showing a majority of null investment in GT, while Mexico has 56.10% of the surveyed firms investing moderately in this technology. Robotics is one of the technologies that have been put in practice for repetitive manufacturing operations. They improve the reliability and precision of the processes, and if they are used in ideal situations, they improve the quality and the flexibility of the process in general. Besides, there are dangerous operations that should not be performed by humans that can be performed by robotics. This technology has not been a very popular one since the high implementation and maintenance costs must be justified by a high degree of improvement in the operations. Most of the surveyed firms show no investments in robotics (USA: 57.89%, Costa Rica: 72.97% and Mexico: 55.42%). Finally, automated inspection is helping in improving quality and timeliness in the manufacturing processes. Manual inspections are not as reliable and fast as automated ones. However, the investment is high and the new trends are to do things right since the first time, and inspection is not supposed to take place, since the errors are detected immediately right after they occur. Therefore, it was expected that most of the firms would not invest in automated inspection (USA: 68.42%, Costa Rica: 60.61% and Mexico: 49.37%).

MANUFACTURING	No Investment			Moderate investment			Heavy Investment		
	USA	CR	MX	USA	CR	MX	USA	CR	MX
NC machines	22.22	34.21	24.39	55.56	60.53	63.41	22.22	5.26	12.20
CAM	40.00	50.00	27.71	50.00	47.37	61.45	10.00	2.63	10.84
Environmental control systems	29.41	18.92	7.32	70.59	81.08	92.68	0.00	0.00	0.00
Bar coding	35.00	25.64	20.51	60.00	69.23	75.64	5.00	5.13	3.85
Real-time process control systems	57.89	15.38	14.29	31.58	71.79	80.95	10.53	12.82	4.76
FMS	30.00	41.67	27.06	65.00	55.56	70.59	5.00	2.78	2.35
AHS	52.63	41.67	32.14	47.37	55.56	59.52	0.00	2.78	8.33
GT	58.82	61.11	41.46	41.18	36.11	56.10	0.00	2.78	2.44
Robotics	57.89	72.97	55.42	42.11	27.03	38.55	0.00	0.00	6.02
Automated inspection	68.42	60.61	49.37	31.58	36.36	45.57	0.00	3.03	5.06

*Table 2. AMT investments in Manufacturing.*

In general, the three countries are showing moderate investments in advanced manufacturing technologies for the processes. However, the case of group technology, robotics and automated inspection confirm that the purpose is not to invest in every single new AMT, but to choose the appropriate technology that adapts to the manufacturing processes and to the organization. In the case of implementing new technologies that are not compatible to current organizational cultures or current manufacturing processes, a change in the latter must be done carefully. The key to success in current markets is expressed by the integration of customer satisfaction, low costs, high quality, rapid response, flexibility, innovation and outstanding service. All these key variables are influenced by the use of technology within the organization and they can be improved by selecting the appropriate strategies.

Advanced technologies applied to administration operations are part of AMT. We need to find ways of improving the efficiency and efficacy of our decision processes, information handling, response times and communication along the organization. MRP is the materials requirements planning is a computerized information system developed to aid in managing dependent-demand inventory and scheduling replenishment orders. It is a technology that helps in reducing inventories, improve labor and facilities utilization and increase customer service. MRP has increased its importance in the last decades, as a result, heavy investments have been done in Costa Rica (18.42%) and Mexico (21.18%) and mostly, moderate investments (USA: 72.22%, Costa Rica: 65.79% and Mexico: 68.24%). Office automation includes developing in house database systems, using computers for word-processing, spreadsheets and presentation software. It is the introduction of computers to administration operations within a corporation. Most firms have invested moderately in office automation (USA: 83.33%, Costa Rica: 76.32% and Mexico: 57.65%). Manufacturing Resource Planning (MRP II) relates areas such as manufacturing, purchasing, marketing, finance and engineering in one interrelated system. As expected, the investment in MRP II is less than in MRP. The percentage of firms investing moderately in MRP II is similar for USA (63.16%), Costa Rica (63.16) and Mexico (62.35%). Activity-based costing systems is a new accounting approach for distributing costs according to the activities required for getting a final product. It does not distribute costs evenly among products and it is performed using computer software that performs the calculations right after the other linked systems receive input information. In USA firms, the same percentage of firms are not investing in ABC and are investing moderately (44.44%). In Costa Rica, 76.92% of the firms invest

moderately in ABC and the percentage is Mexico is 66.67% for moderate investment. Electronic mail has become very popular in the past few years. It has become a very easy and fast way of communicating in an informal way through the organization. Interesting enough, 80% of USA firms invest moderately in this technology, same as 66.67% of Costa Rican companies and 57.65% of Mexican companies. The interesting part is that only 10% of American firms have a heavy investment in e-mail, while 30.77% and 38.82% in Costa Rican and Mexican companies, respectively. Electronic Data Interchange (EDI) are integrated systems in which computers at one organization are linked by phone lines or some other communication channel and exchange data directly with computers at another organization. It has been used in suppliers' relationships and it is used to link companies along the supply chain. In this technology, a moderate investment has been done for the majority of USA (63.16%) and Mexican firms (56.47%). But in Costa Rica, similar percentages are found in no investment (31.58%), moderate investment (44.74%) and heavy investment (26.32%). It is relevant to note that again, Mexico has a high percentage in heavy investment ( 28.24%). Decision Support Systems (DSS) are information systems that are linked to other operational systems in the organization and that help in the decision-making process of the management of an organization. They are feed with data from the processes and their output are optical or closed to optimal solutions to specific problems. In the USA, the majority of the firms haven't invested in this technology (61.11%). On the other hand, moderate investment in DSS dominates Costa Rican (63.89%) and Mexican (72.84%) firms. Knowledge-Based Systems (KBS) include what it is known as artificial intelligence. There are information systems that are capable of learning from the situations that they are faced with, and therefore, the future decisions depend on the effectiveness of the solutions given in the past to similar problems and to the new information that has been provided to the system. It has not been dispersed among organizations to invest in KBS at this moment (USA: 58.82%, Costa Rica: 65.63% and Mexico: 41.03%). However, Mexico shows a high percentage in moderate investments (46.15%), while 41.18% of American and 34.38% of Costa Rican firms also invest moderately in KBS. Again, the trend in all three countries is in moderate investment in advanced administrative technologies. It can be suggested that AMT is in a growing stage and therefore, in the future, the investment in AMT could grow for achieving greater performance measures and competitive advantage.

ADMINISTRATION	No Investment			Moderate investment			Heavy Investment		
	USA	CR	MX	USA	CR	MX	USA	CR	MX
MRP	22.22	15.79	10.59	72.22	65.79	68.24	5.56	18.42	21.18
Office automation	11.11	0.00	0.00	83.33	76.32	57.65	5.56	23.68	42.35
MRP II	31.58	10.53	7.06	63.16	63.16	62.35	5.26	26.32	30.59
ABC	44.44	2.56	3.57	44.44	76.92	66.67	11.11	20.51	29.76
E-mail	10.00	2.56	3.53	80.00	66.67	57.65	10.00	30.77	38.82
EDI	31.58	28.95	15.29	63.16	44.74	56.47	5.26	26.32	28.24
DSS	61.11	33.33	19.75	38.89	63.89	72.84	0.00	2.78	7.41
KBS	58.82	65.63	41.03	41.18	34.38	46.15	0.00	0.00	12.82

Table 3. AMT investments in Administration.

### Driving forces for initiating AMT investments

The driving forces for initiating AMT are the reasons for taking up the idea and implementing various advanced manufacturing technologies in different areas of the organization, from design to administration. Why are firms going for AMT?

American companies stated that the most important reasons for implementing AMT are continuous improvement (70%), followed by flexibility (55%) and customer demands (55%). In Costa Rica, the most important driving forces for AMT are continuous improvement (80%) and competition (72.50%). For Mexican companies, the most important reasons for pursuing AMT are competition (72.50%) followed by continuous improvement (69.41%).

It is important to notice that companies perceive AMT as a solution for continuous improvement. Also, in the two developing countries (Costa Rica and Mexico), there is a new variable that drives to implementing AMT, which is competition. These countries have been forced to achieve competitive advantage in order to keep and improve their positions in the current markets full of heavy competition.

AMT DRIVERS	Not at all important			Somewhat important			Very important		
	USA	CR	MX	USA	CR	MX	USA	CR	MX
Customer demands	20.00	25.00	15.29	25.00	27.50	29.41	55.00	47.50	55.29
Increase quality	31.58	52.50	38.82	42.11	25.00	24.71	26.32	22.50	36.47
Wider product range required	31.58	27.50	27.06	26.32	35.00	25.88	42.11	37.50	47.06
Competition	10.53	7.50	7.06	42.11	20.00	22.35	47.37	72.50	70.59
Continuous improvement	0.00	5.00	5.88	30.00	15.00	24.71	70.00	80.00	69.41
Annual budget	30.00	48.72	28.92	45.00	38.46	45.78	25.00	12.82	25.30
Company strategy	20.00	2.50	2.35	30.00	35.00	47.06	50.00	62.50	50.59
Increase productivity	40.00	50.00	40.00	50.00	37.50	43.53	10.00	12.50	16.47
Increase flexibility	10.00	5.00	7.06	35.00	45.00	52.94	55.00	50.00	40.00

Table 4. Driving forces for pursuing AMT.

### AMT Planning, and Implementation Activities

It is important to determine what are the activities for AMT planning and implementation that firms are expending the most resources (money and time). Table 5 shows the results for the three countries in study classified in no effort at all, moderate effort and maximum effort. We used a scale of 7-points, being 1 no effort at all and 7 maximum effort. USA invested in activities such as top management involvement (5.05), financial investment evaluation prior to installation (5.06) and ensuring capability of AMT with existing production systems (4.84). Costa Rica used more resources in planning and implementation activities such as ensuring vendor commitment during and after the installation (5.25), matching capabilities of AMT to benefits expected by the plant (5.18) and linking manufacturing to business strategy (5.10). The Mexican companies use their resources in matching capabilities of AMT to benefits expected by the plant (5.41), ensuring vendor commitment during and after the installation (5.41) and financial investment evaluation prior to installation (5.39).

There were two activities that were the least common for investing time and money for the three countries. First, hiring/retaining AMT experts/staff. This means to have exclusive people to AMT projects and implementation. Second, firms are not hiring external consultants for implementing new advanced manufacturing technologies.

### AMT Performance

The AMT performance was measured in two categories: operations performance and competitive advantage (compared to the firm's competitors). Our purpose was to determine what benefits are perceived as the most important ones for the companies. Table 6 presents the details for USA, Costa Rica and Mexico.

AMT IMPLEMENTATION	No effort at all			Moderate effort			Great effort		
	USA	CR	MX	USA	CR	MX	USA	CR	MX
Multi-disciplinary implementation teams	25.00	2.50	3.53	60.00	70.00	65.88	15.00	27.50	30.59
Monitoring AMT being used	33.33	7.50	7.06	66.67	62.50	72.94	0.00	30.00	20.00
Considering impacts on customers	0.00	12.82	13.25	85.00	61.54	51.81	15.00	25.64	34.94
Matching capabilities of AMT to benefits expected by the plant	0.00	0.00	0.00	63.16	52.50	36.47	36.84	47.50	63.53
Ensuring compatibility of AMT with existing production systems	5.26	2.63	2.50	47.37	57.89	43.75	47.37	39.47	53.75
Coordinating marketing and manufacturing strategies	11.11	5.13	4.82	77.78	61.54	44.58	11.11	33.33	50.60
Ensuring vendor commitment during and after the installation	6.25	7.50	4.71	62.50	37.50	30.59	31.25	55.00	64.71
Obtaining the services of knowledgeable AMT consultants	38.89	28.21	22.50	50.00	41.03	47.50	11.11	30.77	30.00
Top management involvement	0.00	5.00	0.00	47.37	50.00	64.71	52.63	45.00	35.29
Linking manufacturing to business strategy	11.76	0.00	0.00	52.94	56.41	54.22	35.29	43.59	45.78
Developing system performance measures prior to installation	11.76	15.00	10.59	64.71	67.50	61.18	23.53	17.50	28.24
Hiring/retaining AMT experts or plant staff	33.33	18.92	12.66	55.56	51.35	64.56	11.11	29.73	22.78
Having multi-skilled production workers	11.11	5.00	4.71	72.22	70.00	60.00	16.67	25.00	35.29
Communicating the likely impact of new AMT to all plant workers	15.00	5.00	4.71	60.00	62.50	58.82	25.00	32.50	36.47
Emphasizing teamwork and group activities	5.00	2.56	6.02	70.00	48.72	49.40	25.00	48.72	44.58
Pre-installation training	20.00	5.00	2.35	40.00	50.00	51.76	40.00	45.00	45.88
Strategic investment evaluation	16.67	0.00	0.00	66.67	70.00	62.35	16.67	30.00	37.65
Considering likely impacts on suppliers	27.78	2.56	2.35	66.67	71.79	72.94	5.56	25.64	24.71
Developing a long term automation strategy	16.67	2.50	3.53	72.22	62.50	55.29	11.11	35.00	41.18
Multi-disciplinary planning teams	30.00	7.69	7.23	65.00	66.67	59.04	5.00	25.64	33.73
Choosing knowledgeable project leaders	5.56	5.00	2.35	72.22	62.50	41.18	22.22	32.50	56.47
Financial investment evaluation prior to installation	5.56	2.63	2.44	44.44	57.89	37.80	50.00	39.47	59.76

Table 5. AMT planning and implementation activities.

As shown in the following table, productivity, consistency and control over manufacturing processes are highly rated by Costa Rica (74.36%, 74.36% and 79.49% respectively) and Mexico (74.70%, 68.67% and 72.50% respectively). In USA, the improvements related to AMT are shown in consistency (50%) and productivity (45%) and image is considered to be improved to some extent by using AMT (68.42%).

OPERATIONS PERFORMANCE	Not at all			To some extent			To a very large extent		
	USA	CR	MX	USA	CR	MX	USA	CR	MX
Productivity	0.00	5.13	0.00	55.00	20.51	25.30	45.00	74.36	74.70
Consistency	0.00	5.13	0.00	50.00	20.51	31.33	50.00	74.36	68.67
Control	5.00	0.00	0.00	60.00	20.51	27.50	35.00	79.49	72.50
Switching costs	31.25	5.88	0.00	43.75	58.82	60.26	25.00	35.29	39.74
Flexibility	20.00	0.00	0.00	40.00	42.11	36.71	40.00	57.89	63.29
Market share	47.06	0.00	0.00	35.29	59.46	48.10	17.65	40.54	51.90
Customer commit.	17.65	2.78	0.00	58.82	72.22	52.56	23.53	25.00	47.44
Non-imitative innovations	17.65	5.26	5.00	52.94	50.00	45.00	29.41	44.74	50.00
Image	5.26	2.56	2.47	68.42	43.59	29.63	26.32	53.85	67.90

Table 6. Operations Performance with AMT.

The other performance measure is how the companies rate themselves compared to their competitors in key manufacturing components for competitive advantage. The results guide to quality (USA: 89.47%, Costa Rica: 71.79% and Mexico: 73.49%), flexibility (USA: 47.37%, Costa Rica: 72.97% and Mexico: 70.51%) and dependability, which means always meeting customers' requirements and delivery dates (USA: 63.16%, Costa Rica: 71.79% and Mexico: 71.08%).

COMPETITIVE ADVANTAGE	Significantly worse			Equal			Significantly better		
	USA	CR	MX	USA	CR	MX	USA	CR	MX
Unit cost	5.88	2.63	2.41	64.71	76.32	73.49	29.41	21.05	24.10
Fast delivery	5.26	2.63	0.00	57.89	36.84	45.68	36.84	60.53	54.32
Quality	0.00	2.56	0.00	10.53	25.64	26.51	89.47	71.79	73.49
Flexibility	0.00	0.00	0.00	52.63	27.03	29.49	47.37	72.97	70.51
Cycle time	5.56	2.86	0.00	61.11	42.86	32.43	33.33	54.29	67.57
New products	18.75	2.63	0.00	50.00	52.63	66.67	31.25	44.74	33.33
Dependability	0.00	0.00	0.00	36.84	28.21	28.92	63.16	71.79	71.08

Table 7. Competitive Advantage Components compared to competitors.

## Conclusions

The results of the preliminary study show that continuous improvement is a strong driving force for pursuing AMT in the three countries. Differences exist when other forces are involved, in the case of USA, AMT is implemented by seeking for more flexibility and for satisfying customer demands. In the case of Costa Rican and Mexican companies, the second most important driving force for implementing AMT is competition. This is natural since these countries are developing

countries that are in more need of achieving competitive advantages in order to keep and improve their positions in the current markets full of heavy competition.

The investments in AMT vary from country to country. However, there was a pattern in design investments since most companies in the three countries were investing moderately in CAD (Computed-Aided Design) more than in CAE (Computed-Aided Engineering) or even less in CAPP (Computed-Aided Process Planning). It seems that investment in manufacturing is more moderate than heavy in the three countries. Companies are investing moderately in mostly three of the manufacturing technologies mentioned in the survey, namely, Numeric Control Machines, Flexible Manufacturing Systems and Bar Coding. The purpose of a successful AMT implementation must be not to invest in every single new AMT, but to choose the appropriate technology that adapts to the manufacturing processes and to the organization. Advanced technologies applied to administration operations are part of AMT. In this section of AMT, the investments show that companies are pursuing to implement, by moderate investments, MRP, e-mail and office automation and decision support systems. Again, the trend in all three countries is in investing moderately in advanced administrative technologies, same as in design and manufacturing technologies. It can be deduced that AMT is in a growing stage and therefore, in the future, the investment in AMT could grow for achieving greater performance measures and competitive advantage.

Planning and implementation activities are important to analyze the strategic way of implementing AMT in the different countries. USA invested in activities such as top management involvement, financial investment evaluation prior to installation and ensuring capability of AMT with existing production systems. Costa Rica used more resources in ensuring vendor commitment during and after the installation, matching capabilities of AMT to benefits expected by the plant and linking manufacturing to business strategy. The Mexican companies use their resources in the same two first activities implemented in Costa Rica, however, they also add resources in financial investment evaluation prior to installation.

In terms of performance, enhancements in flexibility, dependability and quality were perceived as the most important competitive advantages gained by the use of AMT.

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