

RETURN ON INVESTMENT STUDY FOR MEDICAL SIMULATION TRAINING:

Immersion Corporation Laparoscopy AccuTouch® System

*A Frost & Sullivan report
performed in conjunction with the*

**American Hospital
Association**

HRET

HEALTH RESEARCH &
EDUCATIONAL TRUST
In Partnership with AHA

Transforming health care through research and education

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SUMMARY

From October 2003 to March 2004, Frost & Sullivan conducted a return on investment (ROI) study on three training simulators sold by Immersion Medical, Inc.¹ These simulators have been in use by hospitals and training programs for a sufficient period of time to allow an in-depth evaluation of their performance.

The study included in-depth interviews and surveys of 237 attending staff physicians, residency directors, nursing directors, nurses, risk managers, and CFOs or controllers in hospitals, universities, and community colleges across the U.S. The Health Research and Educational Trust (HRET), the research affiliate of the American Hospital Association, provided access to the study's control group—145 medical personnel who did not use Immersion Medical simulators.

For the Laparoscopy AccuTouch System, its median payback period was found to be 169 days. Of the 85% of survey respondents who reported that their institution performs financial analysis prior to making a purchase, the desired payback period for capital expenditures ranged from one to more than six years.

In addition to financial benefits, 94% of survey participants reported that nurses, residents, and other trainees would prefer to train on medical simulators prior to live patients.

The aim of the study was to identify factors that contribute to ROI and to build an interactive ROI calculation model. Institutions can use the calculation model to determine ROI for their own situation. The model allows them to compare their input data to the median values of more than 200 separate institutions, and it provides several financial metrics: payback period, net present value, internal rate of return, and return as a percentage of the initial cost of the simulator.

The subject of this report, the Laparoscopy AccuTouch System, provides an effective learning experience by digitally recreating the procedures and environment of abdominal keyhole surgery. The system uses advanced 3D technology and graphics synchronized to the user's actions to provide a realistic virtual working environment. To train for a number of real-life scenarios,

practice sessions can vary in graphic complexity and difficulty. Factors found to be important in determining ROI for a training simulator follow. Survey results were used to quantify the financial benefits, which are detailed in the body of this report.

Financial Benefits

- Procedural time savings
- Instructor time savings
- Reduction in errors resulting in fewer complications and cancellations
- Financial value of faster time to competence
- Reduction in equipment breakage costs
- Reduction in alternative training costs
- Revenues from selling practice time on the simulator

Costs

- Costs associated with deploying the simulator

Non-financial Benefits

- Recruiting enhancement
- Evaluating trainees
- Credentialing new hires
- Better quality of care
- Trainee satisfaction

Payback Period

Using the median values from the survey data (Appendix B, Values for Laparoscopy AccuTouch System ROI Model), the ROI model calculates that the first year totals for the Laparoscopy AccuTouch System are:

- » Benefits – \$168,767
- » Costs² – \$76,000
- » Payback Period – 169 days

¹CathSim AccuTouch System, Endoscopy AccuTouch System, and Laparoscopy AccuTouch System with Surgical Science LapSim modules.

²Costs include space the system occupies, training program preparation, and Laparoscopy AccuTouch System with all available software modules.

WHY THIS STUDY?

The purpose for the Frost & Sullivan study:

- To find what factors contribute to ROI for the Laparoscopy AccuTouch System
- For each ROI factor, determine the median value through surveys, then
- Build an interactive ROI calculation application, so that
- Anyone considering the purchase of an Immersion Medical simulator could calculate the payback period for their unique situation and consider the experience of other like institutions

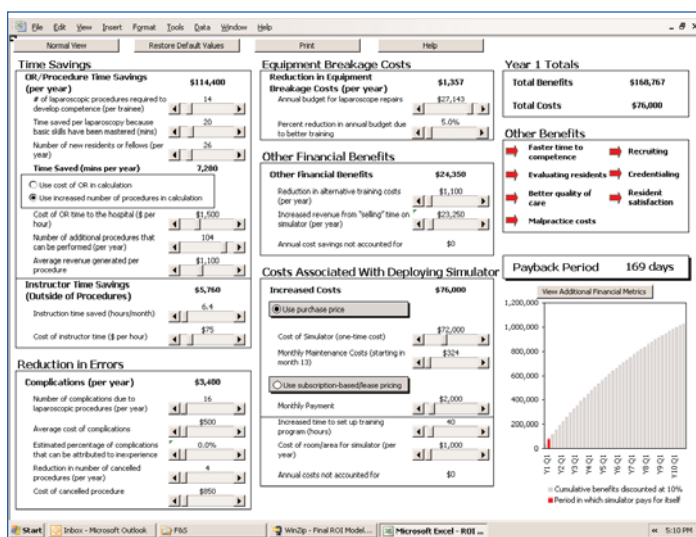


Figure 1: ROI Model

The first page of the model sets out the categories and more specific factors contributing to ROI (see [Results for the Laparoscopy AccuTouch System](#), page 4). The model allows users to input their own numbers, such as the "Number of laparoscopic procedures required to develop competence (per trainee)," then automatically calculates the payback period for the Immersion Medical simulator. Additional pages of the model reveal more detailed findings from the study.

Due to the many benefits of minimally invasive procedures, their use continues to rise. Reduced hospital stays, reduced post-procedure pain, shorter recoveries, and reduced costs have all resulted. And because most such procedures require advanced surgical skills, devices that help teach the necessary technique are likely to be increasingly valued.

Medical simulation is a relatively new technology, and to its proponents, a necessary one. Immersion Medical simulators can help clinicians acquire and maintain motor skills and cognitive abilities, and they can also be used to measure and certify competency. A training regimen using Immersion Medical simulators allows medical professionals to experience a variety of medical situations. Many believe that simulators will prove to be as useful in training clinicians as they have been in training airline pilots.

And while most people will concede the logic of using simulators as training devices in medicine, a comprehensive cost-benefits analysis of their use has not yet been produced. This study is the first attempt to quantify return on investment for medical simulators—because to justify a capital equipment purchase, a hospital or training institution needs both a clinical and a cost-benefit justification.

Immersion Medical engaged Frost & Sullivan to do this study with the reasoned assumption that the results would help hospitals and other training institutions verify the cost, benefits, and ROI for Immersion Medical simulators. (See also Appendix A, [Desired Payback Period vs. Study Results](#).)

This paper reports only on the results found for the Laparoscopy AccuTouch System. For other simulator ROI results, or to receive access to the Laparoscopy AccuTouch System ROI model, please contact the Marketing department at Immersion Medical.

Study Design and Participants

This study was conducted in two phases to provide the most accurate and complete evaluation of data. In the first phase, in-depth interviews with users of Immersion Medical Laparoscopy AccuTouch System identified the factors that contribute to ROI. In addition, their opinions were used to identify a number of other, non-financial benefits to be considered in a larger data collection phase.

In the second phase, representatives from hospitals and teaching institutions, divided into control and Immersion Medical simulator user groups, completed online surveys that provided the median values used in the ROI model. (See Appendix B, [Values for Laparoscopy AccuTouch System ROI Model](#).)

The Health Research and Educational Trust, the research affiliate of the American Hospital Association, provided access to the control group for this study's purposes. The total number of participants in each phase is shown in Figure 2.

Figure 2: Study Participants

Platform	Phase 1	Phase 2
	No. of Interviews	No. of Surveys
Vascular Access	10	39
Laparoscopy	3	10
Endoscopy	15	15
Control		145
TOTAL	28	209

RESULTS

Results for the Laparoscopy AccuTouch System

The Laparoscopy AccuTouch System is used for training physicians in laparoscopy. The study found costs associated with deploying the simulator included cost of the simulator, monthly maintenance fee, time to integrate the simulator into the training program, and cost of the room. Financial contributions of the system were found in the areas of:

- Time savings – operating room (O.R.) or procedural time savings, as well as instructor time saving
- Reduction in errors – comprised of complications and cancellations
- Financial value of faster time to competence
- Reduction in equipment breakage costs
- Other financial benefits – including reduction in alternative training costs and revenues from selling practice time on the simulator

Procedural Time Savings

O.R. or procedural time savings requires a calculation of time saved per trainee per year when the Laparoscopy AccuTouch System is used to gain proficiency and therefore speedier technique. Since this time may accrue in either the O.R. or in less expensive procedural rooms, users must choose whether to use the cost of O.R. time or the increased number of procedures in the calculation.

If cost of O.R. is chosen, the total amount of time saved is multiplied by the cost of O.R. time to determine the total benefit in O.R. time savings. If procedure time savings is chosen, the number of additional procedures that could be performed in the procedure room per year is multiplied by the average revenue generated per procedure to calculate the total benefit for procedural time savings.

- » Based on median values from the survey data, the annual financial benefit in procedural time savings for the Laparoscopy AccuTouch System is \$114,400.

Instructor Time Savings

Two factors were required to evaluate instructor time savings—instruction time saved, calculated from survey results, and cost of instructor time. The instruction time saved multiplied by the cost of instructor time determines the total benefits for this factor.

- » Based on the survey's median value, the annual financial benefit in instructor time savings for the Laparoscopy AccuTouch System is \$5,760.

Reduction in Errors

Reduction in errors³ results in a financial contribution from fewer complications and cancellations that can be attributed to better early training in laparoscopy procedures.

Several additional inputs are required:

- Number of complications due to laparoscopic procedures per year
- Average cost of complications
- Estimated percentage of complications that can be attributed to inexperience
- Reduction in the number of cancelled procedures per year
- Cost of a cancelled procedure

The final value is calculated by determining the financial value of fewer complications and adding that to the financial value of fewer cancelled procedures.

³Typical laparoscopy errors include:

- Inappropriate insufflation
- Metabolic acidosis
- Use of excessive local anesthetic
- Improper/inadequate removal of polyp or tissue sample
- Rupture
- Excessive bleeding

- » Based on the median values from the survey, the annual financial benefit in reduction in errors for the Laparoscopy AccuTouch System is \$3,400.

Faster Time to Competence

Faster time to competence relates to the notion that the faster a resident, fellow, or other trainee can achieve proficiency at laparoscopic procedures, the more valuable they are to the institutions that employ them. The value of faster time to competence is dependent on the number of trainees and the estimated financial impact of having a larger pool of competent staff. Since the concept that trainees provide a financial benefit to the training institution is not universally accepted, users may choose to disregard this benefit and remove it from the ROI model's calculation.

- » Based on median values from the survey data, the annual financial benefit in faster time to competence for the Laparoscopy AccuTouch System is \$19,500.

Equipment Breakage Costs

Another financial benefit of better training is reduction in laparoscopic repair costs, which are incurred because of improper tool handling. The calculation is based on the facility's annual laparoscopic repair budget and an estimate of the percentage that it would be reduced if trainees had access to a medical simulator that teaches better tool handling technique.

- » Based on the survey's median values, the annual financial benefit in equipment breakage costs for the Laparoscopy AccuTouch System is \$1,357.

Other Financial Benefits

Two additional benefits that have been identified through the course of this study are reduction in alternative training costs and increased revenue from selling practice time on the simulator.

- » Based on median values from the survey, the annual financial benefit in "Other" for the Laparoscopy AccuTouch System is \$24,350.

Costs Associated with Deploying the Simulator

In the interactive ROI model, the cost of owning the simulator can be set to function for either simple purchases or leasing programs. The information required includes the purchase price and any monthly maintenance fees. The default price is based on

the Laparoscopy AccuTouch System with all available software modules.⁴ The calculation includes costs for the time needed to integrate the simulator into the training program, the space the simulator occupies, and any additional annual costs associated with owning a simulator.

- » Based on median values from the survey, the costs associated with deploying a Laparoscopy AccuTouch System total is \$76,000.

Payback Period for Laparoscopy

Using the median values from the survey data (Appendix B, Values for the Laparoscopy AccuTouch System ROI Model), the ROI model calculates that the first year totals for the Laparoscopy AccuTouch System are:

- » Benefits – \$168,767
- » Costs – \$76,000
- » Payback Period – 169 days

Frost & Sullivan and Immersion Medical invite you to use the interactive ROI model to help determine your own unique payback period.

For a description of the Monte Carlo simulation of the ROI model and its key output – payback period – see Appendix C, Calculating Payback Period with Monte Carlo Simulation.

Non-financial Benefits

Non-financial Benefits Found To Be Common To All Immersion Medical Simulators

In addition, the study found several non-financial benefits that were common to all Immersion Medical simulators:

- Recruiting enhancement
- Evaluating trainees
- Credentialing new hires
- Better quality of care
- Trainee satisfaction

⁴Laparoscopy AccuTouch System with LapSim Basic Skills 2.0 and Dissection modules.

Recruiting Enhancement

During the early in-depth interviews, it was found that one of the unexpected benefits of owning an Immersion Medical simulator was the interest shown in them by potential recruits. Survey participants confirmed this benefit.

- » 88% of participants reported that recruiting was a priority at their institution
- » 55% of participants indicated that they believe medical students consider the quality of training equipment when selecting a training program
- » 75% of Immersion Medical simulator users reported using their simulator as a recruiting tool

Evaluating Residents and Other Trainees

As Phase 1 interviews revealed, providing objective documentation of progress for residents and other trainees is a challenge to many residency directors. Immersion Medical simulators provide a possible solution by tracking trainee progress using an evaluation module. This module provides objective measurements for each simulated procedure. Survey participants asserted the need for objective documentation of this kind.

- » 76% of participants reported tracking the progress of residents and other trainees
- » 83% of participants desire an objective measurement of resident and trainee progress

Credentialing New Hires

Another benefit identified during early interviews and quantified by survey results was the simulator's usefulness in evaluating the skills of potential new hires.

- » 74% of participants currently evaluate the skills of new hires
- » 69% of participants expressed a desire for an objective measurement of new hires' skills

Better Quality of Care

One of the top priorities for all hospitals is to provide a better quality of care. For hospitals certified by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), establishing better quality of care has special meaning. Because JCAHO rates the quality of care provided by its hospitals, most of these facilities set aside significant monies to improve their quality of care scores.

- » On average, institutions dedicate approximately \$40,000 per year to JCAHO quality of care initiatives. The two most commonly reported areas of spending for JCAHO quality of care initiatives were medication safety and staff training and education.

In particular, staff training and educational efforts are consistent with medical simulator training. In addition, competency evaluations (ranked fourth by participants) and RN retention and recruiting efforts (ranked sixth by participants) may also benefit from in-house medical simulator training.

Resident/Trainee Satisfaction

Another unanticipated benefit identified in Phase 1 interviews was an improvement in resident and other trainee satisfaction. Most residents and trainees were thrilled to be able to develop their skills on a simulator prior to trying their technique on patients.

All participants in the Phase 2 interviews were asked a series of questions concerning resident and trainee satisfaction.

- » 89% of participants reported that trainee satisfaction is a priority to their institution
- » 88% of participants reported that the quality of training equipment is an important component of trainee satisfaction
- » 94% of participants reported that residents and other trainees would prefer to train on medical simulators prior to live patients
- » 75% of Immersion Medical simulator users believe that the use of medical training simulators has contributed to improved resident and trainee satisfaction

Frost & Sullivan and Immersion Medical invite you to use the interactive ROI model to help determine your own unique payback period.

Appendix A

Desired Payback Period vs. Study Results

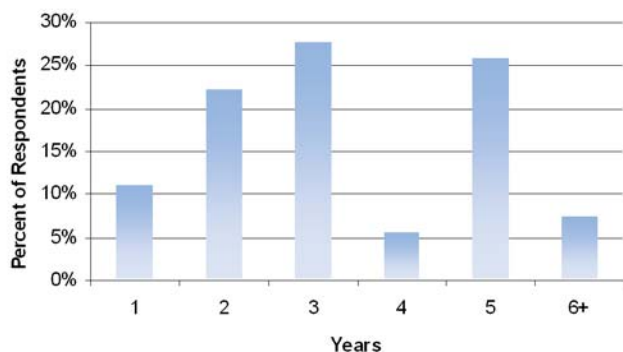
The participants in the data collection portion of this project were asked a number of general questions in addition to questions specific to the ROI models.

One of the most important and basic questions asked of all participants was whether or not their hospital performed any sort of financial analysis prior to purchasing capital equipment.

- » 85% of respondents reported that their hospital performs financial analysis prior to purchasing capital equipment.

When asked to identify the desired payback period for capital expenditures, the responses ranged from one to more than six years. Approximately 45 percent of respondents indicated that desired payback period varied depending on the type of equipment. The distribution of responses for participants who were able to identify a desired payback period is shown in Figure 3.

Figure 3: Desired Payback Period for Capital Equipment



- » The payback period calculated for the Immersion Medical Laparoscopy AccuTouch System, based on median data from survey responses, was 169 days.

Appendix B

Values for the Laparoscopy AccuTouch System ROI Model

The factors identified by interviewees as important to include in an ROI study, the median values from the survey, and the minimum and maximum range of responses for those factors are shown. The right-hand column indicates whether the factor was treated as a variable or a fixed input in the Monte Carlo simulation (see Appendix C, Calculating Payback Period with Monte Carlo Simulation). When the factor is variable, numbers from within the range of survey responses were used in the Monte Carlo iterations.

Factors Identified as Important	Median Value	Range of Survey Responses		Monte Carlo Setting for Simulation
		Minimum	Maximum	
Number of procedures required to develop competence (per trainee)	14	5	40	Variable
Time saved per procedure (minutes)	20	0	30	Variable
Number of new trainees (per year)	26			Fixed
Use cost of O.R. time or number of additional procedures	Procedures			Fixed
Cost of O.R. time to the hospital (\$ per hour)	\$1,500			Fixed
Number of additional procedures that can be performed (per year)	104	52	156	Variable
Average revenue generated (per procedure)	\$1,100			Fixed
Instructor time saved (hours/month)	6.4	0	24	Variable
Cost of instructor time (\$ per hour)	\$75			Fixed
Number of complications due to laparoscopy procedures (per year)	16	4	33	Variable
Average cost of complications	\$500			Fixed
Percentage of complications that can be attributed to inexperience	0%	0%	0%	Variable
Reduction in number of cancelled procedures (per year)	4	3	5	Variable
Cost of cancelled procedure	\$850			Fixed
Increased value of resident or fellow due to faster time to competence (per year)	\$750	\$0	\$2,000	Variable
Annual budget for laparoscope repairs	\$27,143	\$10,000	\$75,000	Variable
Percent reduction in annual budget due to better training	5%	0%	8%	Variable
Reduction in alternative training costs (per year)	\$1,100	\$300	\$5,500	Variable
Increased revenue from selling time on the simulator (per year)	\$23,250	\$0	\$150,000	Variable
Annual cost savings not accounted for	\$0			Fixed
Cost of simulator	\$72,000			Fixed
Monthly maintenance costs	\$324			Fixed
Increased time to integrate simulator into training program (hours)	40			Fixed
Cost of room/area for simulator (per year)	\$1,000			Fixed
Annual costs not accounted for	\$0			Fixed

Appendix C

Calculating Payback Period with Monte Carlo Simulation

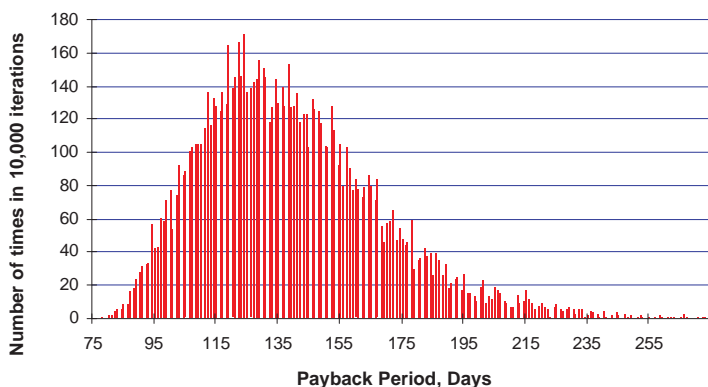
Frost & Sullivan used Monte Carlo simulation in Immersion Medical's ROI-based models. Monte Carlo simulation allows for changing multiple input variables at the same time and predicting the impact on a key output.⁵ The number of surveys completed in Phase 2 provided sufficient data to perform a Monte Carlo simulation of the model and its key output—payback period.

The individual factors used to determine the payback period were assigned median values and set as either fixed or variable inputs. For variable inputs the range of values collected from the surveys was entered. Simulation of the payback period using over 10,000 iterations was performed. Results of this simulation yielded several key statistics surrounding the payback period, Figure 4. Figure 5 shows the distribution of results for the simulation.

Figure 4: Key Payback Period Statistics, Monte Carlo Simulation

Statistic	Value
Mean	139 days
Median	135 days
Minimum	78 days
Maximum	320 days
Standard Deviation	29.6 days

Figure 5: Distribution of Simulated Payback Periods for Laparoscopy AccuTouch System



Ten thousand random combinations of variables produced the distribution shown above. For example, the payback period for the Laparoscopy AccuTouch System was 95 days about 40 times out ,000. It was 115 days about 130 times out ,000. *Source: Frost & Sullivan, 2004*

⁵More information on Monte Carlo simulation can be found at <http://www.decisioneering.com/monte-carlo-simulation.html>

About Frost & Sullivan

Frost & Sullivan was founded in 1961 with a specific mission: To work with clients to create value through innovative growth strategies. The firm helps clients achieve their growth objectives through its unique Growth Consulting process based on 40 years of experience working with companies across most major technology industries. The process begins with the definition of client needs and growth objectives and culminates in the delivery of strategic recommendations based on comprehensive primary research. Focusing on clients' core objectives and market opportunities, Frost & Sullivan provides strategic insights and recommendations that maximize clients' success.

About the American Hospital Association and HRET

The American Hospital Association (AHA) is the national organization that represents and serves all types of hospitals, health care networks, and their patients and communities. Close to 5,000 hospitals, health care systems, networks, other providers of care, and 37,000 individual members come together to form the AHA.

The research affiliate of the American Hospital Association, the Health Research and Educational Trust (HRET), has the goal of advancing ideas and practices beneficial to health care practitioners, institutions, consumers, and society at large. Its principal activities focus on identifying, exploring, demonstrating, and evaluating key strategic health care issues affecting innovative health care delivery systems, educating the field about the implications of changing health policies, and developing strategies for community health improvement.

About Immersion Corporation

Founded in 1993, Immersion Corporation is the recognized leader in digital touch technology and products. Immersion's technology is deployed across automotive, consumer electronics, entertainment, industrial, medical training, and mobile products. Immersion holds more than 700 issued or pending patents in the U.S. and other countries.

Medical line of business

TouchSense haptic technology has revolutionized medical education. Medical schools and hospitals train practitioners in minimally invasive procedures using our surgical simulators. Our patented technologies bring tactile, audio, and visual realism to medical education, creating an engaging multisensory experience that increases clinical proficiency, decreasing medical errors and cost.

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