

The Use of Process Engineering In Planning, Vendor Selection, and Installation of a New Digital Imaging Solution (PACS) and Radiology Information System (RIS) for a University Hospital Radiology Department



Submitted by Mike Boutet



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About the Organization

- Major university teaching hospital with 450 beds.
- Radiology department has 40 radiologists doing 280,000 studies per year.
- Function of department is to provide high-quality clinical radiology services.



The Project Team

- Independent process improvement consultant
- University director of finance



The Problem

A major university teaching hospital required assistance and leadership in planning, vendor selection, and installation of a new digital imaging solution (PACS) and radiology information system (RIS) for its clinical radiology department.



Project Goals

- To identify the return on investment for the installation of a new digital imaging solution (PACS) and radiology information system (RIS).
- To design and implement a measurable business transformation and workflow process re-engineering.



Root Cause Analysis

Examined methods for accomplishing the following improvements:

- Reduced vendor cost without affecting quality or speed of project execution through reduced contract, software maintenance, and professional services costs.
- Increased throughput on existing digital imaging equipment such as CT, MRI, and X-ray equipment without increasing capital expenditures.
- Reduced incidence of medical billing errors.
- Increased revenue through adoption of best practices and training.
- Achievement of first-year savings and cost avoidance targets.



Addressing Root Causes

Cross-functional teams were used to identify potential savings and operational efficiencies.



Return on Investment

\$2,300,000

**in savings were identified for
the first year of the project.**



Return on Investment

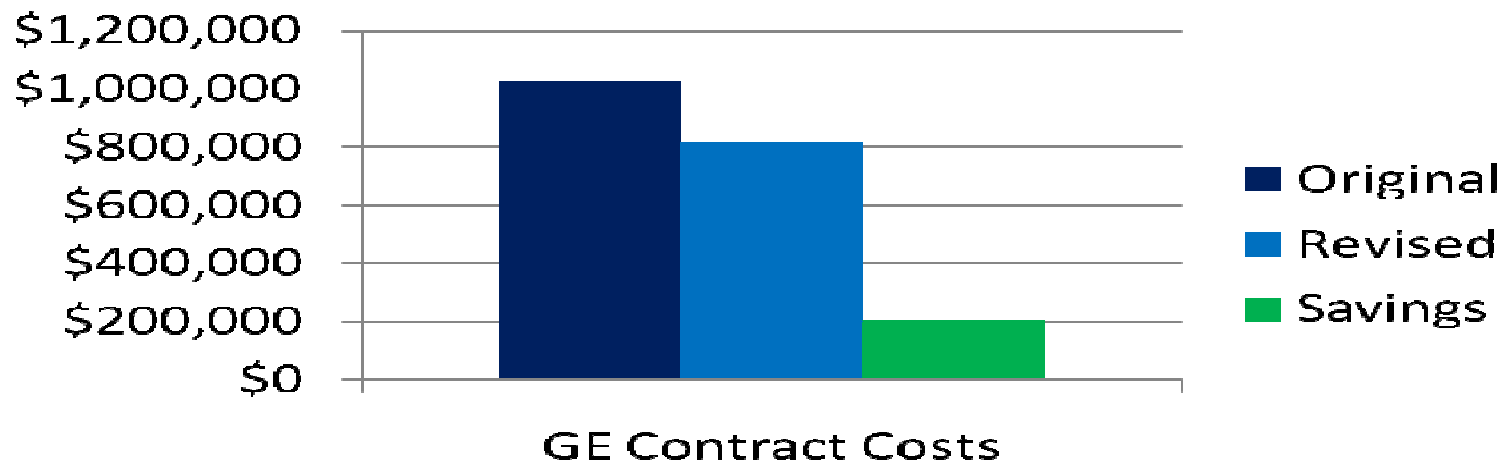
Value Recognized Total Estimated First-Year Savings/Avoidance

<i>Estimated Post-implementation Savings (Year 1)</i>		
Implementation Savings Item	Savings/Cost Avoidance	Comments
GE RIS IC Contract Review and Change Order	\$205,500	Eliminated Gold standard integration, archive reconciliation, Sorian interfaces & combined bi-directional feeds
GE RIS IC Professional Services Savings	\$84,600	Estimated 450 hours saved * \$188/hr
Accelerated RIS/PACS time to value	\$362,078	Accelerated project timeline by 3 mos per original timeline (potential increased exam revenue via increased throughput plus improved billing process)
Monthly maintenance costs reduction	\$16,538	~ 8% reduction in monthly maintenance fees after go-live (12 mos @ \$1,378)
Increased radiology exam revenue	\$1,281,812	Target 1 exam/day per modality for CT, MR, CR/DR
Improved billing process	\$205,000	Improve billing cycle by .025% via elimination of upstream quality issues
Unsigned/unbilled reports	\$166,500	Potential unrecognized revenue for 33% of 1,000 unsigned reports @ \$500/exam. 20-30% wrong visit #s. 70-80% late due to late dictation
Avoidance of 0.5 FTE ITS support (fully loaded)	\$50,000	Phillips provides LTA, local RAID/cache and business continuity server support
Total Estimated Implementation Savings	\$2,372,028	



Return on Investment

Value Recognized

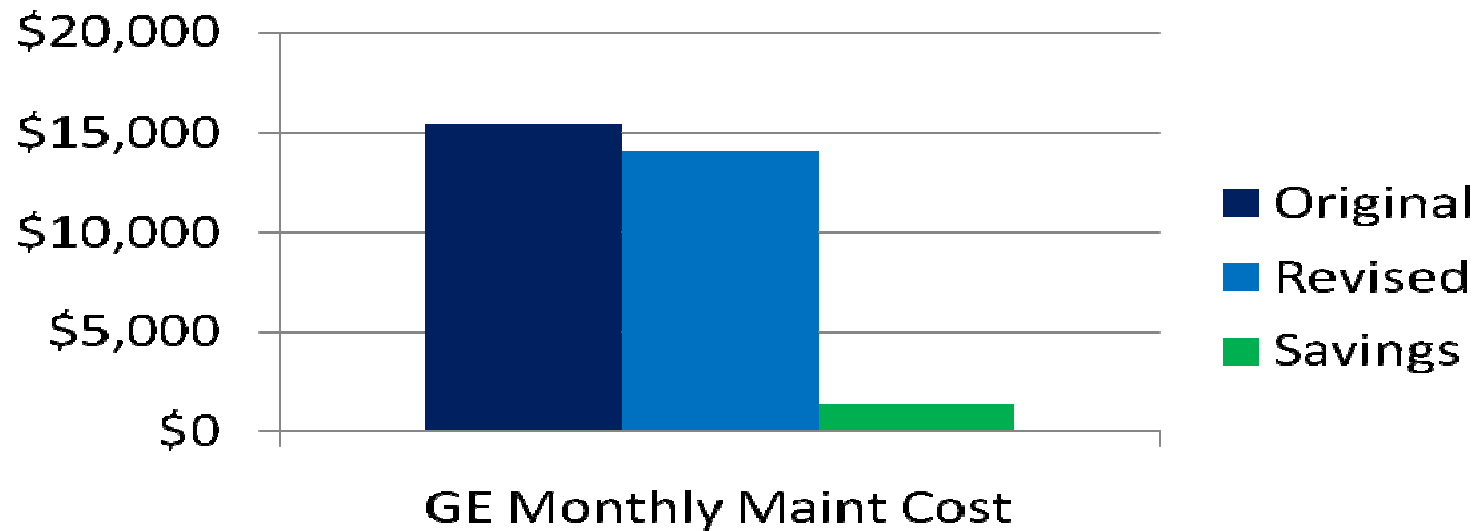


- **RIS contract costs: \$205k value realized**
 - GE change order was approved in October 2008: Removed gold standard, archive reconciliation, Sorian interfaces, & combined bi-directional feeds.



Return on Investment

Value Recognized

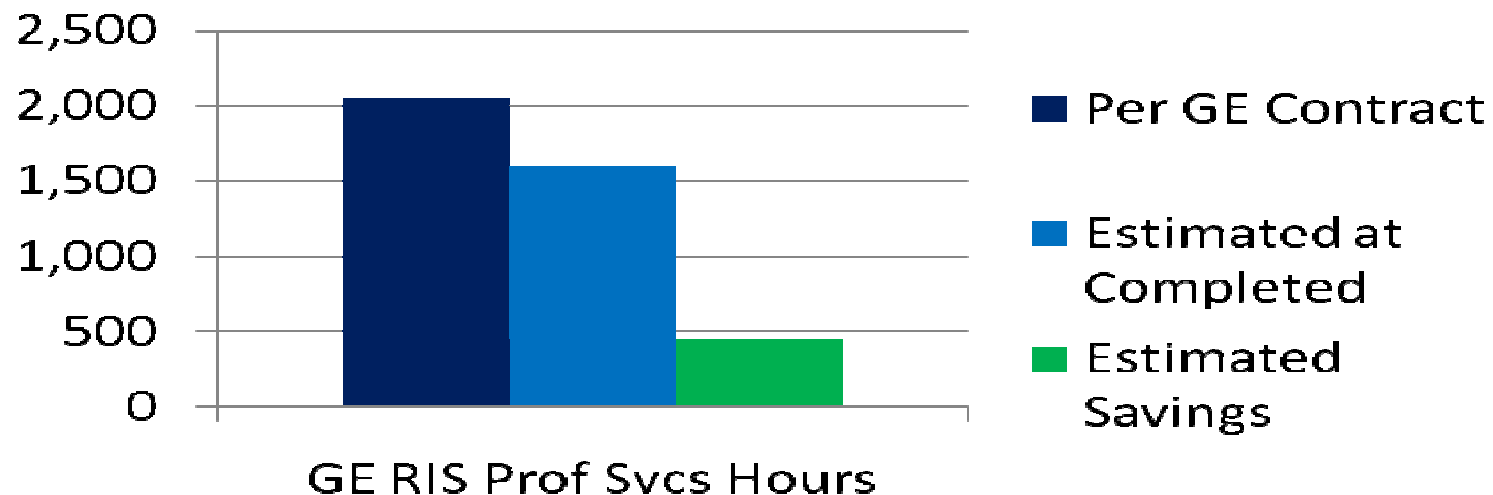


- **RIS maintenance cost: \$16.5k value realized**
 - GE monthly maintenance cost adjusted downwards approximately \$1.4k per month, resulting in 8% annual savings.



Return on Investment

Value Recognized



- **RIS professional services: Estimated 450 professional-services hours saved at \$188 per hour**
 - Expected savings = \$84.6k, a 22% reduction.
 - Hours can be used for system improvements post-go-live.



Return on Investment

Value Recognized

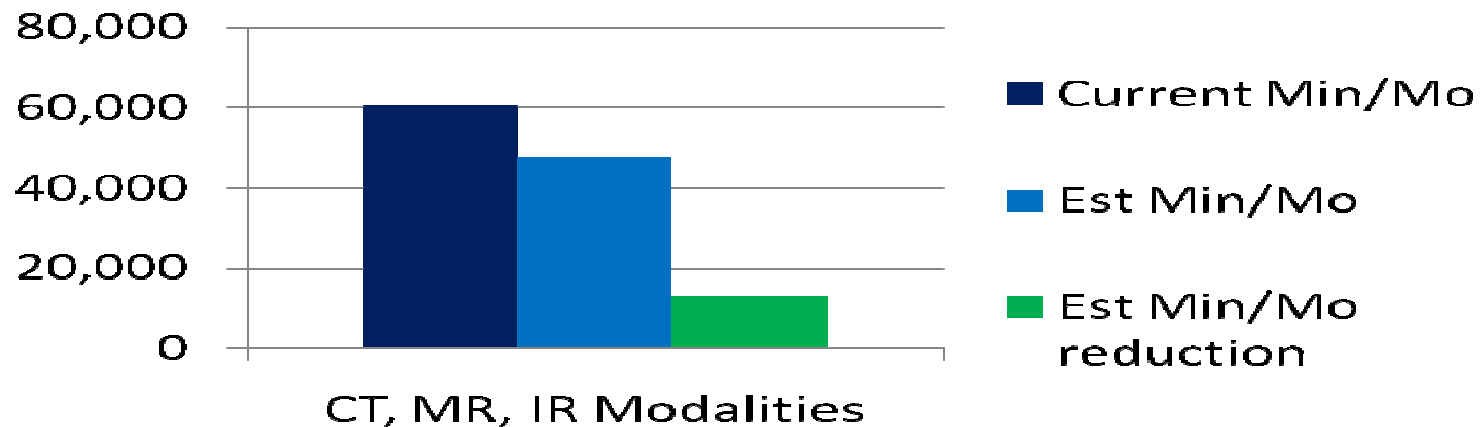
Analysis of v9 to v10 Potential Increase in CT, MR and IR Modality Throughput

v9 Exam Codes	Volume per mo	Duration	v9 Weighted	v10 Exam Codes	Volume per mo	Duration	v10 Weighted	Exam v. Exam Variance	Weighted Variance
CAP1	546	15	8190	CABDPELW	546	15	8190	0	0
CCERV1	262	20	5240	CCSPINEWO	262	10	2620	-10	-2620
CCXR4	53	20	1060	CCESTW	53	15	795	-5	-265
CLUM1	100	20	2000	CLSPINEWO	100	10	1000	-10	-1000
CTSP1	106	15	1590	CTSPINEWO	106	10	1060	-5	-530
CHED1	577	15	8655	CHEADWO	577	10	5770	10	-2885
CMAX1	8	20	160	CMAXW	8	15	120	-5	-40
MBREWW	203	35	7105	MBRAINWWO	203	40	8120	5	1015
MCARWA	142	90	12780	MCARDANWWO	142	45	6390	-45	-6390
MBRR	87	20	1740	MBRAINWO	87	20	1740	0	0
MLSEWW	30	45	1350	MLSPINEWWO	30	45	1350	0	0
MCSEWW	25	45	1125	MCSPINEWWO	25	45	1125	0	0
MTSEWW	14	60	840	MTSPINEWWO	14	45	630	-15	-210
MCSR	56	30	1680	MCSPINEWO	56	35	1960	5	280
MRANR	6	30	180	MRANECKWO	6	20	120	-10	-60
SAEMBO	4	180	720	IAEMBO	4	180	720	0	0
SEXT	3	150	450	IEXTVENLL	3	90	270	-60	-180
SIVCF	17	90	1530	IIVCF	17	90	1530	0	0
SIVCFR	8	90	720	IIVCFREM	8	90	720	0	0
SPTA	8	150	1200	INPTA	8	180	1440	30	240
SCERE	10	120	1200	INCEREBRAL	10	120	1200	0	0
SSTENT	6	150	900	INSTENTEC	6	120	720	-30	-180
Totals	2271	1410	60415		2271	1250	47590	-145	-12825

Estimated % Reduction in Exam Durations from v9 to v10	21.2%
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Return on Investment

Value Recognized



- **Exam durations: Snapshot of high-volume/high-cost CT, MR, IR**
 - Estimated reduction in weighted exams = 21%.
 - Needs further study for ED/IP/OP efficiencies across organizations.



Return on Investment

Value Recognized

U of U: RIS/PACS Value Analysis*				
<i>Increased Radiology Exam Revenue</i>				
Modality	Exam Revenue	Additional Volume/Day	Additional Volume/Year	Additional Revenue/Year
CT	\$1,565	1	260	\$406,900
MRI	\$2,048	1	260	\$532,480
CR/DR	\$410	1	835	\$342,432
Totals:			1,355	\$1,281,812

- Increasing revenue without new capital or operational expenditures.

**Journal of the American College of Radiology*, Volume 2 , Issue 6 , pp. 511 - 519. "Costs, Charges, and Revenues for Hospital Diagnostic Imaging Procedures: Differences by Modality and Hospital Characteristics."

Mean operating expense and charge per procedure:

CT: \$51 and \$1,565;

X-ray and ultrasound: \$55 and \$410;

MRI: \$165 and \$2,048.



Return on Investment

Value Recognized

Expected Project Benefits vs. Results

Expected Benefits	Anticipated/Delivered Results
Improve Radiologists' WF	Decrease non-value add read time by 5% via techs QCing images and reduced delay to view priors. Hanging protocols for CT, MR, DR, CR don't currently exist in legacy system.
Improve report TAT for referring providers	As targeted in KPIs
Improve scheduling for referring providers	As targeted in KPIs
Improve WF via interfaces	Future-state WF delivered; unique training requirements captured and included in training; captured internal and external "voice of the customer"
Modality scheduling efficiencies	Revamped resource schedules and durations for more efficient ops
Improve billing processes	As targeted in KPIs, simplified Exam codes, improved WF and interfaces
Improve doc scanning & management	Inbound/outbound faxing of orders and doc scanning
Improve service levels for ITS support	Per Philips support model and improved ITS
Improve internal and external end-user satisfaction	As targeted in KPIs
Accelerate PACS vendor selection	Completed in 8 weeks and led to accelerated time to value for PACS
Increase confidence for RIS/PACS on-time go-live	Improved original PACS baseline by 4 months and held PACS vendor accountable for on-time delivery
Improve business continuity & DR	Improve policies & procedures, network review, apps fault tolerance, additional PACS h/w at 5 remote site
Future interface testing	Interfaces easier to maintain through biztalk; test plan in place for future upgrades
Deliver standardized training for RIS/PACS	Delivered standardized RIS training for OSS and Techs and model for post go-live; developing for PACS
Improved patient satisfaction	Indirect improvement through better scheduling systems and faster report TATs

Return on Investment

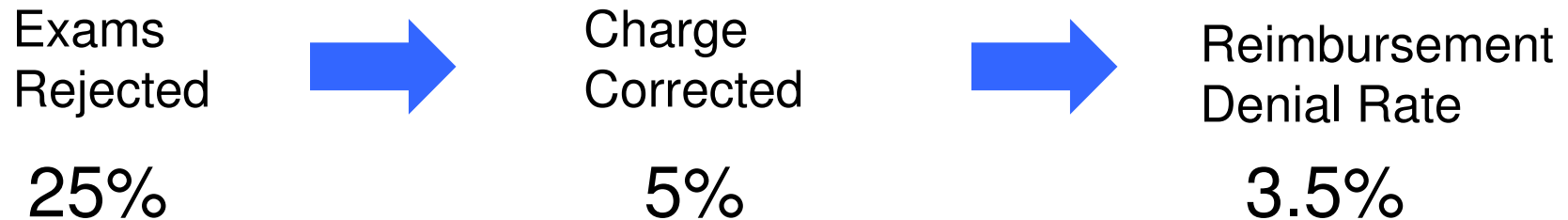
KPIs—Satisfaction, Productivity, & Billing

Key Performance Indicators (KPI Goals)							Baseline		Post-Implementation		
#	Benefit Area	Metric	Definition	Source	Frequency	Owner	Date	Baseline	Target Date	Target Goal	Actual
##	Internal Satisfaction	Radiologist Satisfaction (Faculty)	Level of satisfaction with RIS/PACS/VR and access of medical images and reports measured via a survey with a scale of 1 - 5 (5 is highest level of satisfaction). Survey results may be weighted.	Web-based Survey (Opinio)	6 months	Rick W	3/28/2008	Use 2008 baseline data	6 months post-implementation	30% increase in overall satisfaction rate	TBD
##	Internal Satisfaction	Radiologist Satisfaction (Resident)	Level of satisfaction with RIS/PACS/VR and access of medical images and reports measured via a survey with a scale of 1 - 5 (5 is highest level of satisfaction). Survey results may be weighted.	Web-based Survey (Opinio)	6 months	Rick W	3/28/2008	Use 2008 baseline data	6 months post-implementation	30% increase in overall satisfaction rate	TBD
##	Internal Satisfaction	Technologist Satisfaction	Level of satisfaction with RIS/PACS and access of medical images and reports measured via a survey with a scale of 1 - 5 (5 is highest level of satisfaction). Survey results may be weighted.	Web-based Survey (Opinio)	6 months	Lisa	3/28/2008	Use 2008 baseline data	6 months post-implementation	30% increase in overall satisfaction rate	TBD
##	Internal Satisfaction	OCR	Level of satisfaction with RIS/PACS and access of medical images and reports measured via a survey with a scale of 1 - 5 (5 is highest level of satisfaction). Survey results may be weighted.	Web-based Survey (Opinio)	6 months	Lisa	3/28/2008	Use 2008 baseline data	6 months post-implementation	30% increase in overall satisfaction rate	TBD
##	External Satisfaction	Referring physician satisfaction	Level of satisfaction with access to timely reports measured via a survey with a scale of 1 - 5 (5 is highest level of satisfaction). Survey results may be weighted.	Web-based Survey (Opinio)	6 months	Alison	TBD	Use 2008 baseline data	6 months post-implementation	30% increase in overall satisfaction rate	TBD
##	External Satisfaction	Patient satisfaction (Outpatient)	Level of patient satisfaction with the radiology processes and experience measured via a survey with a scale of 1 - 5 (5 is highest level of satisfaction). Survey results may be weighted.	Web-based Survey (Press Ganey)	Monthly	Lisa	3/28/2008	Use 2007 baseline data	6 months post-implementation	30% increase in overall satisfaction rate	TBD
##	Productivity	Report TAT for Inpatient	Elapsed time measured from when the exam is completed by the Tech to when the report is completed in Prelim status by the Radiologist. 75% of IP reports will be finalized within 4 hrs.	RIS report	Monthly	Diana	3/15/2008	Avg. Time: 4:33hr	6 months post-implementation	>25% reduction in report TATs	TBD
##	Productivity	Report TAT for Outpatient	Elapsed time measured from when the exam is completed by the Tech to when the report is completed in Prelim status by the Radiologist. 75% of OP reports will be finalized within 24 hrs.	RIS report	Monthly	Diana	3/15/2008	75% of exams w/ final report w/in 24hrs, 89% exams w/ prelim report w/in 24 hrs.	6 months post-implementation	>25% reduction in report TATs	TBD
##	Productivity	Report TAT for ED	Elapsed time measured from when the exam is completed by the Tech to when the report is completed in Prelim status by the Radiologist. 75% of ED reports will be finalized within 1 hrs.	RIS report	Monthly	Diana	3/15/2008	Avg. Time: 1:08hr	6 months post-implementation	>25% reduction in report TATs	TBD
##	Productivity	Modality Utilization	Exams per resource. Measured by modality (resource) and tracked monthly for CT/MR/IR/NM/PET	RIS report	Monthly	Diana	3/28/2008	Use 2007 baseline data	6 months post-implementation	>10% increase in utilization rates/resource	TBD
##	Productivity	Unread Reports	Number and type of unread exams >24hours for all modalities	RIS report	Daily	Diana	3/28/2008	Use 2007 baseline data	3 month post-implementation	>10% decrease	TBD
##	Productivity	Next 5th Schedules	Snapshot of open schedules per modality based on forecasted 5th day openings for each modality.	RIS report	Weekly	Diana	3/28/2008	See chart below	3 month post-implementation	>10% decrease next 5th openings	TBD
##	Productivity	Cancellation Rate	Number of same-day exam appointment cancellations (no shows included but coded by "Cancelled" in RIS) by modality and resources for CT/MR/IR/NM	RIS report	Monthly	Brandon	3/15/2008	Use 2007 baseline data	3 month post-implementation	>10% decrease in cancellations	TBD
##	Billing	Technical Fee Processing Time	Average time to process technical fees (gross charge) to meet SLA for 4-day average turn around time starting at date of service.	Monarch system report	Monthly	Kirk	3/28/2008	Use 2007 baseline data	3 months post-implementation	>10% reduction in late fees	TBD
##	Billing	Exam Charges (Tech)	Measurement of the average charge per exam for high revenue modalities to include CT/MR/NM/IR.	Kirk's Spreadsheet	Monthly	Kirk	3/28/2008	Use 2007 baseline data	3 month post-implementation	TBD	TBD
##	Billing	Charge Rejection Rate (Prof)	Measurement of revenue via net charge denial rate	Billing Report	Monthly	Brandy W	3/28/2008	Use 2007 baseline data	3 month post-implementation	TBD	TBD
##	Billing	A/R Days (Prof)	Measurement of revenue via net AR days	Billing Report	Monthly	Brandy W	3/28/2008	Use 2007 baseline data	3 month post-implementation	TBD	TBD
##	Billing	Billing Error Rate (Prof)	Number of incidences and types of billing errors tracked monthly	Billing Report	Monthly	Brandy W	3/28/2008	Use 2007 baseline data	3 month post-implementation	>25% reduction in error rates	TBD

Return on Investment

Value Recognized

Billing Cycle Analysis

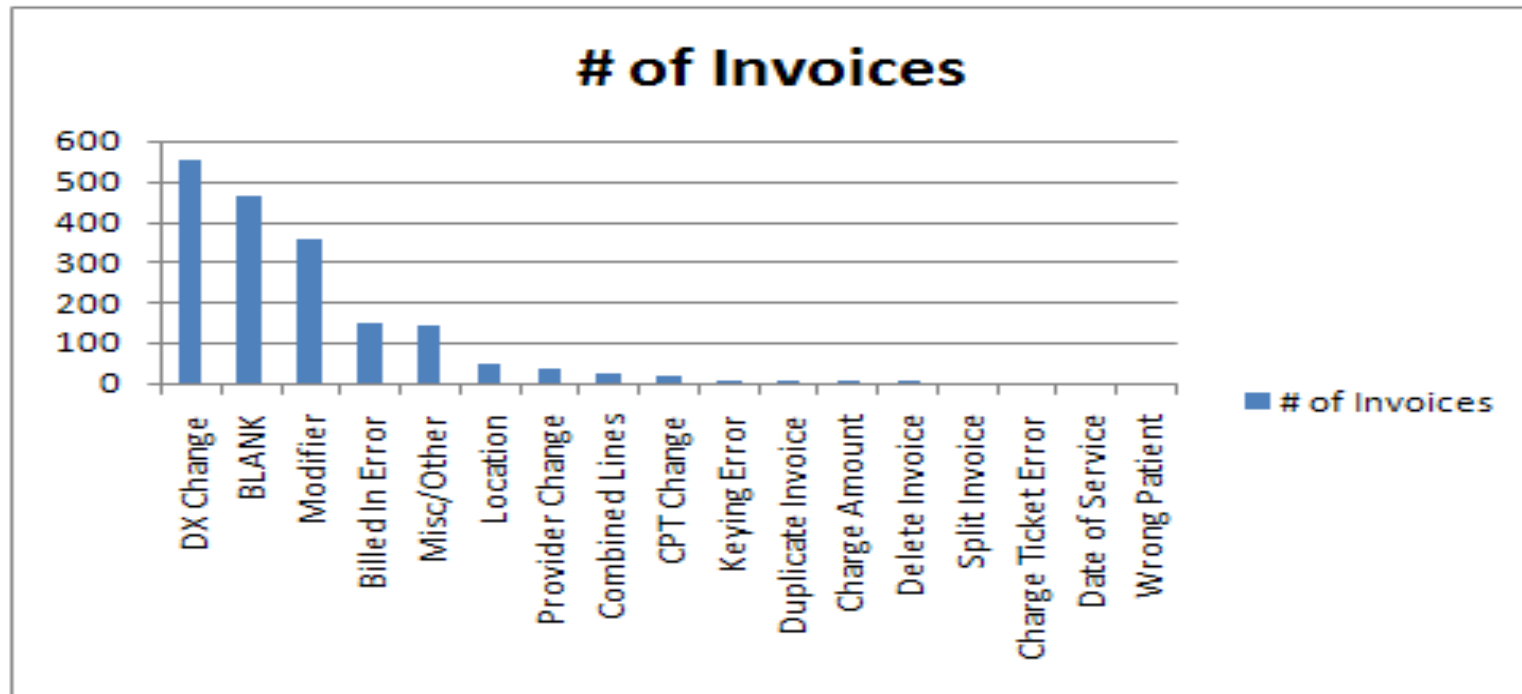


- Rejected exams: modifiers and locations.
- Expected upstream fix: improved technologists' data entry.
- Improved coding queues: v10 document template and line-item fix in RIS.



Return on Investment

Value Recognized



- Billing errors account for rework, late fees, and potentially uncollected revenue.



Return on Investment

Value Recognized

<i>RIS/PACS Potential Revenue Increases</i>			
Year	Total exams	Reduce billing errors by 1 in 500 (0.020%)	Reduce billing errors by 1 in 200 (0.05%)
2007	250,000	\$205,000	\$512,500
Total est. revenue increase:		\$205,000	\$512,500

- Increasing revenue via billing efficiencies.
 - Assumes \$410 per exam.



Monitoring and Evaluating Over Time

- Pre- and post-implementation surveys and financial measures were conducted.
- The post-implementation surveys are not still in progress.

For More Information

- More case study presentations are available from the ASQ Healthcare Division:
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