Developing a Micro Services Architecture Platform to Solve For Radiologist Capacity Challenge

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ABOUT ENVISION HEALTHCARE

• Fortune 500 healthcare provider ($8B annual revenue)
  • 900+ facilities in 45 states (+ 284 ASCs)
  • Envision Physician Services (EVPS) is the largest provider of hospital-based EM/HM, Anesthesiology, Women’s & Children’s, Acute Surgical and Radiology Services (24,000 employed clinicians)

• Recognized leader in Quality Clinical Outcomes, working on providing tools, resources & technologies needed to deliver high-quality patient care, profitably:
  » Quality and performance reporting
  » Operational support
  » Dedicated lean process improvement teams
  » Risk management resources
BUSINESS SEGMENT HIGHLIGHTS

- 12M Radiology Studies
- > 500 Anesthesia Sites
- > 800 Emergency Medicine and Hospitalist Sites
- 80 Neonatology Programs

Focus for this discussion
THE RADIOLOGY ECOSYSTEM & OPPORTUNITY
RADIOLOGY IS A CRITICAL FUNCTION IN HEALTHCARE

Takeaway

- Critical for hospital systems and often the bottleneck for ED throughput
- Critical component of integrated care networks and at risk dollars; data acquisition opportunity between service lines
- Needed for Envision to win system wide multi physician service contracts (“lighthouse accounts”)

Clinically...

80% patients depend on radiology results before treatment

&

Operationally (for hospitals)...

70% of hospital admissions come through the ED where Radiology turnaround times drive throughput

STAKEHOLDERS HAVE SIGNIFICANT PAIN POINTS TODAY

**Patients**
- 16 hours
  - Average report turnaround time

**Physicians**
- 40%
  - Time spent on non-clinical work

**Hospitals**
- Varying Subsidy By Hospital

**Quality**
- 30%
  - Unnecessary tests
  - Inconsistency in findings

REPRESENTS POTENTIAL FOR LARGE PLAYER SUCH AS ENVISION

**SOURCES:**
- Smith-Bindman, Rebecca, et al. "Rising use of diagnostic medical imaging in a large integrated health system." Health Affairs 27.6 (2008): 1491-1502;
- Medscape Radiologist Compensation Report 2015
$100B, Growing Imaging Market ($B)


47  61  65  70  75  81  87  94  102  111

+10%

$20B Professional Radiology Market (%)

Professional 20%
Technical 80%

3 Major Professional Radiology Segments

100% = $20B

Estimates

Teleradiology 10%
On-Site Imaging Center 35%
On-site Hospital 55%

Highly Fragmented Market (%)

100% = $20B

Envision National Providers

Rest of Market

95%
2%
3%
INDUSTRY "HEADWINDS"

Takeaway

Growing shortage of radiologists, market consolidation, declining reimbursement and rising physician compensation presents significant barriers.

Scale and a technology enabled model can turn these headwinds into a competitive advantage for Envision.

Accelerating Consolidation

Rising Physician Compensation

Potential Radiologist Shortage

Radiology FTE By Practice Size

MedScape Radiologist Survey Data

HRSA Radiologist Supply vs. Demand Projections

- **Radiology FTE By Practice Size**: Graph showing the number of full-time equivalents (FTE) for radiology by practice size from 2012 to 2016.
- **MedScape Radiologist Survey Data**: Graph showing rising physician compensation from 2014 to 2017.

**Potential Radiologist Shortage**

- **HRSA Radiologist Supply vs. Demand Projections**: Graph showing projected supply and demand for radiologists from 2000 to 2020.
EVPS IS “SHAPING THE OPPORTUNITY ARENA” – CREATING THE INDUSTRY’S FIRST PHYSICIAN CENTRIC DISTRIBUTED RADIOLOGIST ECOSYSTEM

**EVPS strategy:** combine radiologist scale, domain expertise and clinical outcome data with technology to “flip the script”

**Unique Local / National Partnership Model**

<table>
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<th>Benefits</th>
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<td>✓ Faster turnaround times improve ED throughput</td>
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<td>✓ 24/7 access to sub specialists</td>
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<td>✓ Lower unit cost</td>
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<td>✓ Productivity based comp models</td>
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Onsite + Teleradiology
ENVISION HEALTHCARE – COMMITMENT TO DIGITALIZING OUR BUSINESS

INFO TECH’S ROLE IN ENABLING DIFFERENTIATION STRATEGY

OPERATIONAL CHALLENGES EVPS IS SOLVING FOR
MEETING THE NEEDS OF KEY CONSTITUENCIES

Key needs

Customers
- Access to consistent radiology outcomes (TAT, subspecialty reads, etc.); resulting in faster ED throughput, IP discharge
- Availability of true quality data, performance reporting analytics and performance measures
- Able to comply with CMS regulations
- "Clean" work environment that promotes productivity; including access to leading tools (e.g. viewer, VR, etc.)
- Access to studies in area of expertise
- Transparency into performance

Operators
- Ability to "connect the 12 pods" (route cases to appropriate Rads) & unlock capacity/maximize utilization of resources
- Tools to project outcomes and optimize workforce
- STRATEGIC DIFFERENTIATION – accelerating our hospital system clients transition from "fee for service" to Value Based Reimbursement & preparing for "consumerism"

Radiologists
- "Clean" work environment that promotes productivity; including access to leading tools (e.g. viewer, VR, etc.)
- Access to studies in area of expertise
- Transparency into performance

Ecosystem and Platform to deliver these competencies and help our stakeholders actively differentiate
"TEDR" MIGRATES RADIOLOGISTS READING EXCLUSIVELY ON HOSPITAL PACS TO READING ANY IMAGE IN OUR ECOSYSTEM

**Customer Imaging Studies**

1. **Hospital A**
2. **Hospital B**
3. **IDN Hospital A**
4. **IDN Hospital B**

**EVPS Technology-Enabled Distributed Radiology (TEDR)**

1. **Vendor Neutral Archive**
2. **Zero Footprint Viewer**
3. **Thin Client Viewer**
4. **Worklist**
5. **HL7 Engine**

**EVPS Radiologists**

**Images are load-balanced and reinforce sub-specialties**

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**Envision Healthcare**
Platform Challenges

**Volume**
- Inherent bottlenecks in platform
- Could not scale

**Workforce optimization**
- Clinical Routing Rules Engine configuration is cumbersome
- IFTTT

**Onboard**
- Long lead to onboard new sites
- ~ 6 months from acceptance to release

Team Challenges

**Tech Skills**
- .NET shop (2/3 of onshore dev resources); 1/3 open source
- Captive offshore dev (70+ resources are .NET only)

**Process**
- Different implementations of Scrum
- Varied Product Mgmt. rigor

**Knowledge Base**
- Limited # of Platform SMEs
- Adequate Domain Experts

**BUSINESS CHALLENGE**
Need to “transform” Connect platform to TEDR, while collapsing 3 other ecosystems into it AND still delivering on sub 30 min TAT SLAs and onboarding 20% new growth
Strategic Goals
- Enable business to scale 4x in 4 years
- Support entry into new markets
- Differentiate via "applied innovation"

Architecture Principles
- Reduce inertia
- Eliminate accidental complexities
- Consistent interface and data flows
- No silver bullets

Design & Delivery Practices
- Standard HTTP/REST/AMPQ
- Encapsulate legacy
- Eliminate integration DBs
- Cleanse & master data
- Published integration model
- Small independent services
- Continuous Integration
- Minimal SaaS/COTS customization
Detangle into Micro Services

Monolithic Architecture

Microservices Architecture
LOOSE COUPLING & HIGH COHESION

- PACS
- RIS/HIS
- HL7/DICOM Routing
- Hosted Location
- Inter-operability
- Machine-learning
- Smart Worklists
- Analytics
- Voice Rec
- Support
- Viewer
- End User Devices

Envision Healthcare
Detangle into Micro Services

**MONOLITHS**

- Hierarchical Organization
- Monolith Systems

**SERVICE ECOSYSTEM**

- Agile Organization
- Composable Systems

**MICROSERVICES**
Embrace Diversity!!

Scrum

Product Backing  Sprint & Backlog  Sprint  Working increment if the software

Kanban

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XP

Unfinished Features  Most Important Features  Iterative Planning  A Project Heartbeat  Team Empowerment  Daily Communication  Honest Plans  Working Software
Cloud Agnostic Platform

**DYNAMIC ROUTE SERVICES / API MANAGEMENT**

**APP MICROSERVICES TECHNOLOGY**
- Spring Boot
- Steeltoe
- Spring Cloud Services

**DATA MICROSERVICES TECHNOLOGY**
- Spring Cloud Data Flow
- Cloud Cache
- Rabbit MQ
- MySQL

**PIVOTAL CLOUD FOUNDRY BOSH**

**EMBEDDED OS**
- Win
- Linux

**CREDHUB**

**CLOUD ORCHESTRATION**
- Amazon Web Services
- GCP & Healthcare
- MSFT Azure
- Open Stack
- VMware

**MULTI CLOUD**
ROSETTA HEALTH’S HEALTHBUS 2.0 PLATFORM

Transaction Validation

Data Transformation

Standardization

Rules Processing

Audit & Reporting

Support Integration

TEDR

Dictation

Billing

Support

EDI

EDW

Facility

ORM

ORM

ORU

ADT/FHIR
Micro Services on Cloud Foundry with HealthBus 2.0

HealthBus

- Transaction Validation
- Data Transformation
- Standardization
- Rules Processing
- Audit & Reporting
- Support Integration

Admissions

- ORU
- Facility

- ADT/FHIR + ORM

TEDR

Microservices on Pivotal Cloud Foundry

Quality

Billing

Support

EDW

Standard Data Model (JSON)
OBJECTIVES & KPI

- 22% increase in releases Q3 vs Q2
- Release management: 30% reduction in lead and process time (fewer steps and hand-offs).
- Improved operational metrics: MTTR (< 30 mins), support tickets (< 0.5% of overall transactions)
- Improved security: Faster patching, zero downtime upgrades (> 99.9% Availability)
- Infrastructure usage: Higher density compute, auto-scale and license reductions (Cost/Study < Agreed Upon $ figure)
- Leveraging the big data & algos native to GCP PAAS (while utilizing RDS & Lambda functions in AWS)
WHERE ARE WE IN THE JOURNEY

**Foundational**
- Breakdown silos
- Consolidate platforms
- Align with Business Strategy

**Competitive**
- Keep up with Business scale
- Streamline operations
- Culture Change

**Differentiating**
- Deliver core strategic components
- Improve productivity & capability
- Deliver small ‘innovation’ wins

**Breakaway**
- Deliver Scale
- Drive Innovation
- Establish Industry thought leadership