Lean Healthcare Processes: Effective Technology Integration and Comprehensive Decision Support Using Requirements Engineering Methods

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Takeaways!

"What did you take away from the meeting?

- In healthcare, Lean provides systematic methods to improve processes; however, it mainly focuses on patients' goals, often ignoring those of caregivers and others
- Requirements engineering (RE) provides recognized practices for the elicitation, modeling, analysis, specification, validation, and management of requirements
- Lean-AbPI combines the strength of Lean management (identifying patient values, process waste, and measures) and RE-based modeling methods (providing a comprehensive view of stakeholders and a holistic, evidence-based evaluation of potential solutions)

Motivations

- Many healthcare institutions are implementing value-based systems to improve the quality of provided services
- *Lean management*, which is borrowed from the manufacturing industry, has been introduced in healthcare over 15 years ago
- But healthcare is different from manufacturing
  - Products (e.g., cars) are all similar, but patients are all very different
  - Healthcare is very dynamic, with different/changing needs of many stakeholders & users
  - Healthcare is knowledge intensive, with humans in the loop
- Technology is a key enabler of improvements; however, it is still often unwelcomed by caregivers

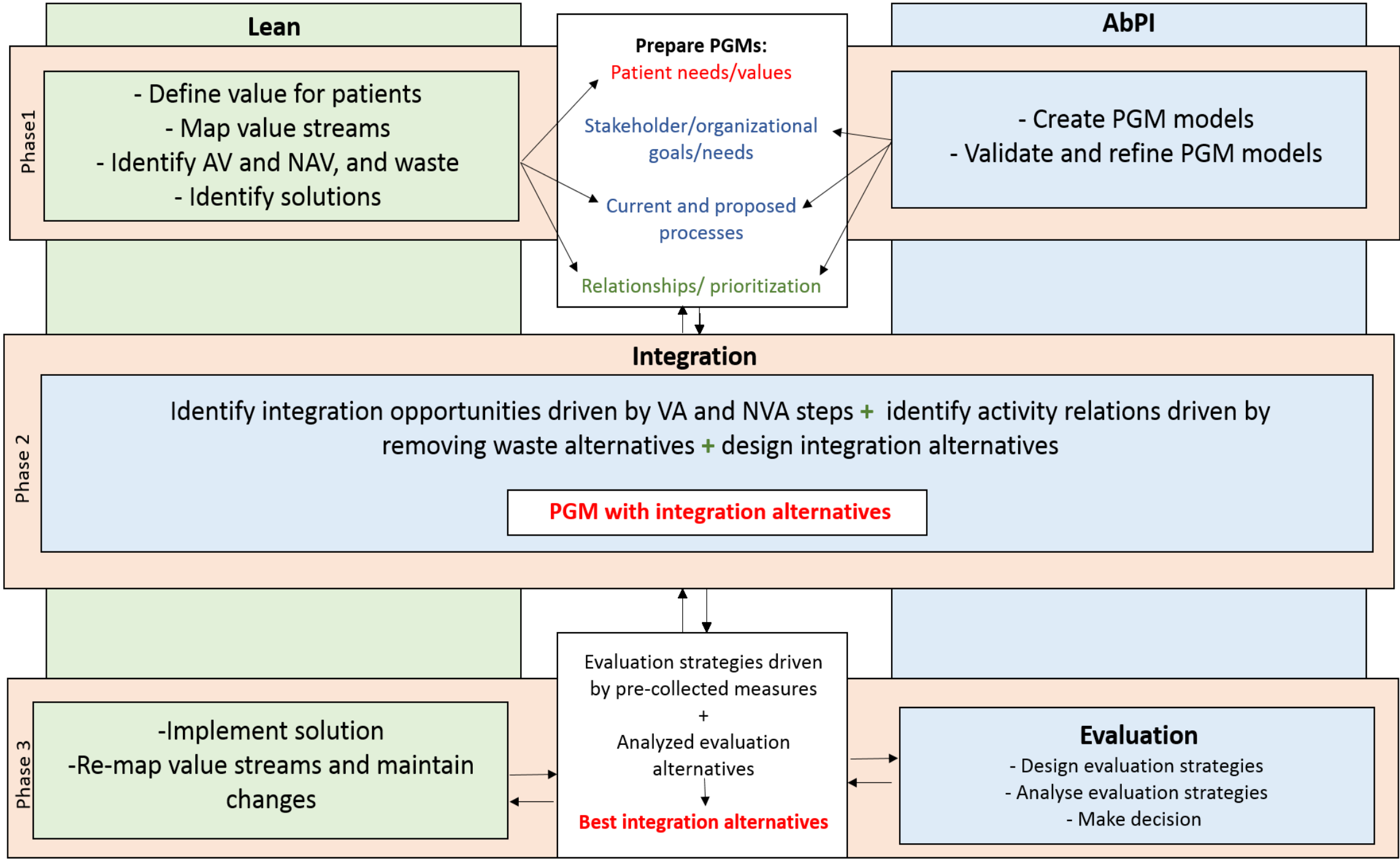
Objectives

- Ensure that all elements (patients values, caregivers needs, hospital goals, units requirements, etc.) of the context under study are fully captured
- Provide a comprehensive evaluation and assessment of the solutions prior to the implementation of (technology-related) changes
- Supports quantitative decision making with trade-off analysis of solutions

Definitions

- **Activity-based Process Integration (AbPI)**
  - RE-based approach that uses **goal** and **process** modelling
  - Assess the potential impact of new system integrations on current practices, organizational goals, and user satisfaction
- **Lean management**
  - Focuses on eliminating waste (by reducing costs or minimizing time, for example) without sacrificing productivity
    - Added value (AV) and non-added value (NAV) tasks
  - Relies on identifying customer/patient values and mapping process activities to those values, to increase service quality

Proposed Model



Case Study

- Lab sample management at Al-Rass Hospital


Iran
Alexandria
الإسكندرية
Jerusalem
Jordan
Israel
Cairo
القاهرة
Kuwait
Egypt
Dammam
الدمام
Persian Gulf
Al Rass General Hospital
Bahrain
Dubai
دبي
Riyadh
الرياض
Qatar
Al Ain
العين
Medina
المدينة المنورة
United Arab Emirates
Saudi Arabia
Mecca
مكة
Oman
Red Sea
Sudan
Yemen

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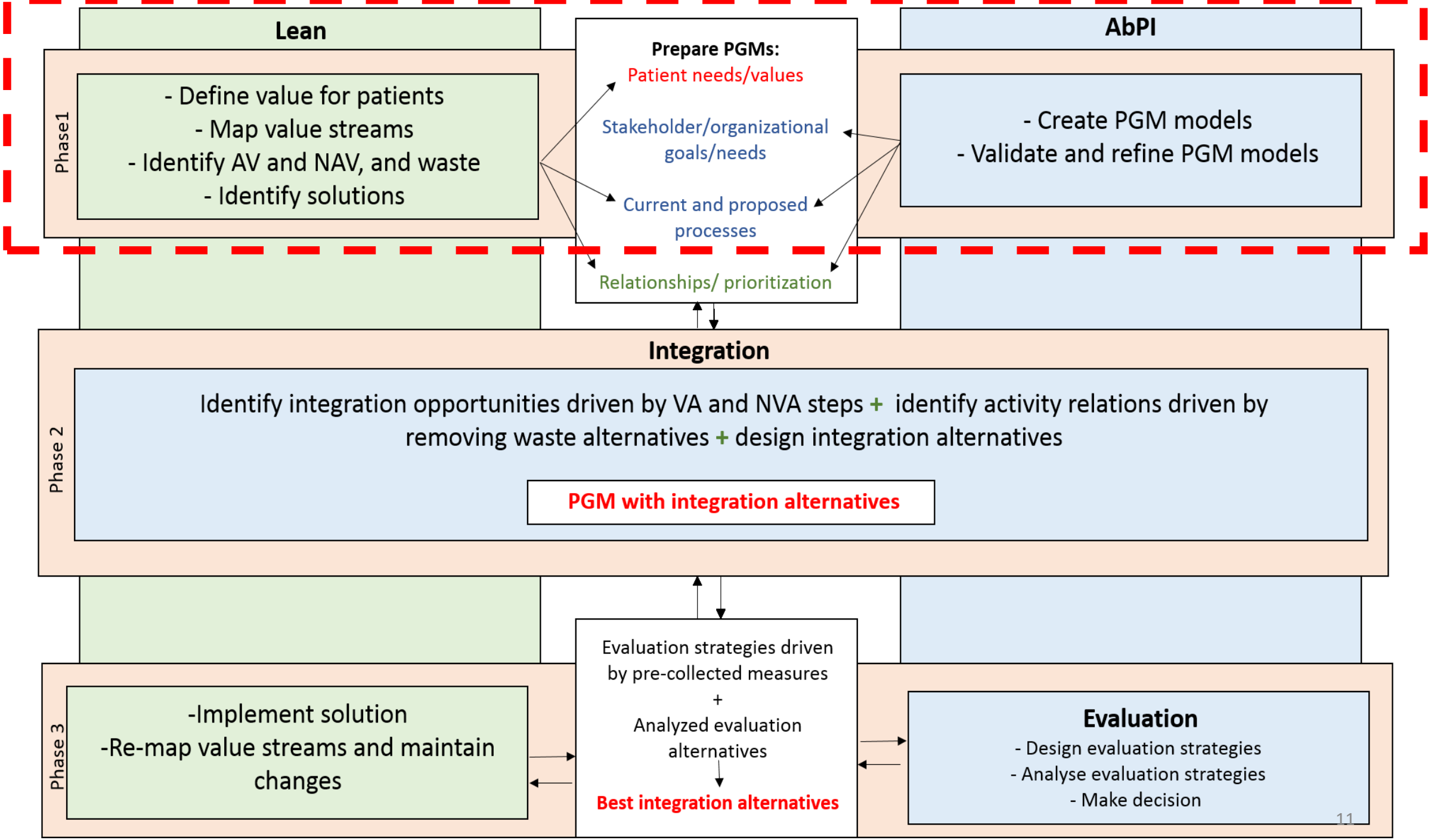
Example - Problem Definition

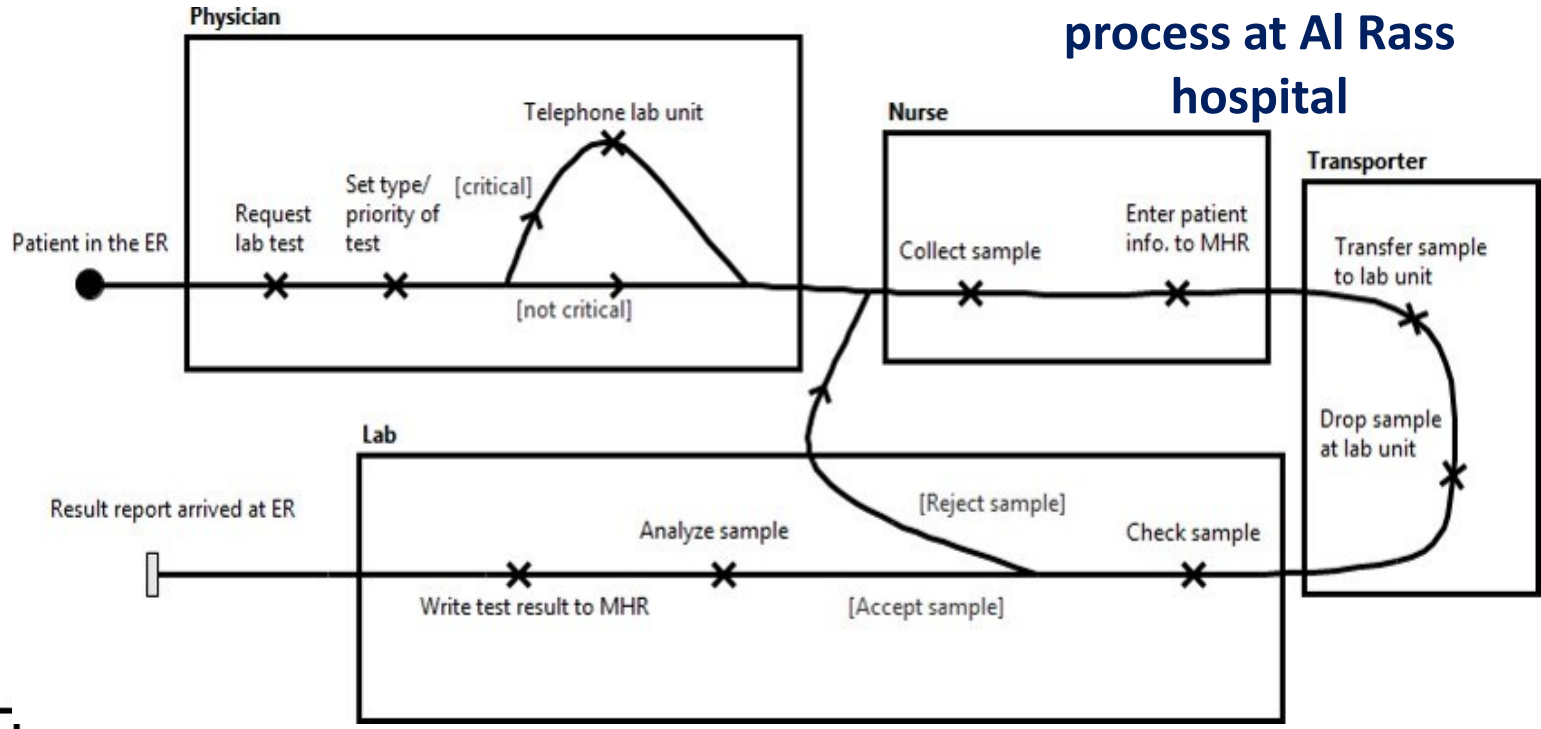
- Al-Rass Hospital suffers from a delay between delivering lab samples from the Emergency Room (ER) and receiving results from the Lab
- Three levels of test urgency: Critical, Urgent, or Routine
- Lean team recently started a project to minimize the delay
- Solution proposed: customized **Real-Time Tracking Sample system (RTTS)** to track samples in real time
- RTTS comes with a cost and new tasks to be performed by caregivers
- The Lean-AbPI model is used to support the decision on whether to deploy the RTTS system (and where) or not.

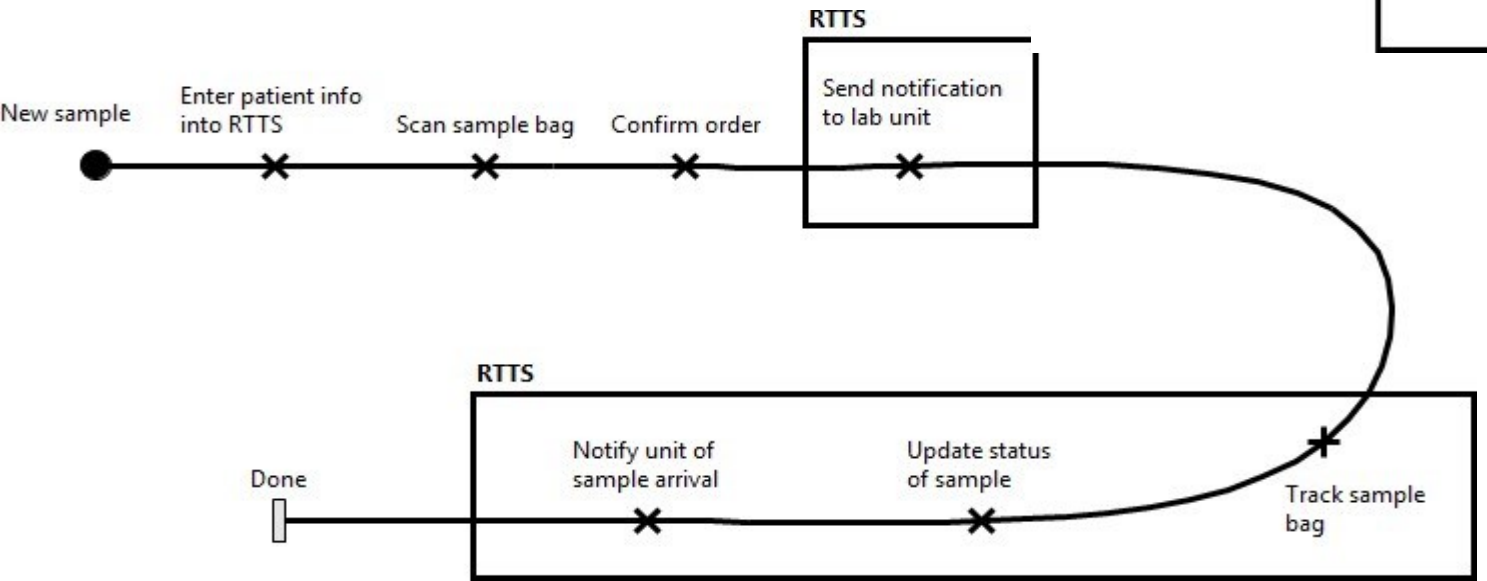

Lean
AbPI
Phase1
- Define value for patients
- Map value streams
- Identify AV and NAV, and waste
- Identify solutions
Prepare PGMs:
Patient needs/values
Stakeholder/organizational goals/needs
Current and proposed processes
Relationships/ prioritization
- Create PGM models
- Validate and refine PGM models
Integration
Phase 2
Identify integration opportunities driven by VA and NVA steps + identify activity relations driven by removing waste alternatives + design integration alternatives
PGM with integration alternatives
Phase 3
-Implement solution
-Re-map value streams and maintain changes
Evaluation strategies driven by pre-collected measures
+
Analyzed evaluation alternatives
Best integration alternatives
Evaluation
- Design evaluation strategies
- Analyse evaluation strategies
- Make decision

Phase 1: Value Definitions and Model Preparation

- Identified waste was Transportation between activities and Waiting.
- The Lean team identified Automation as an optimal solution

Current (as-is) process at Al Rass hospital

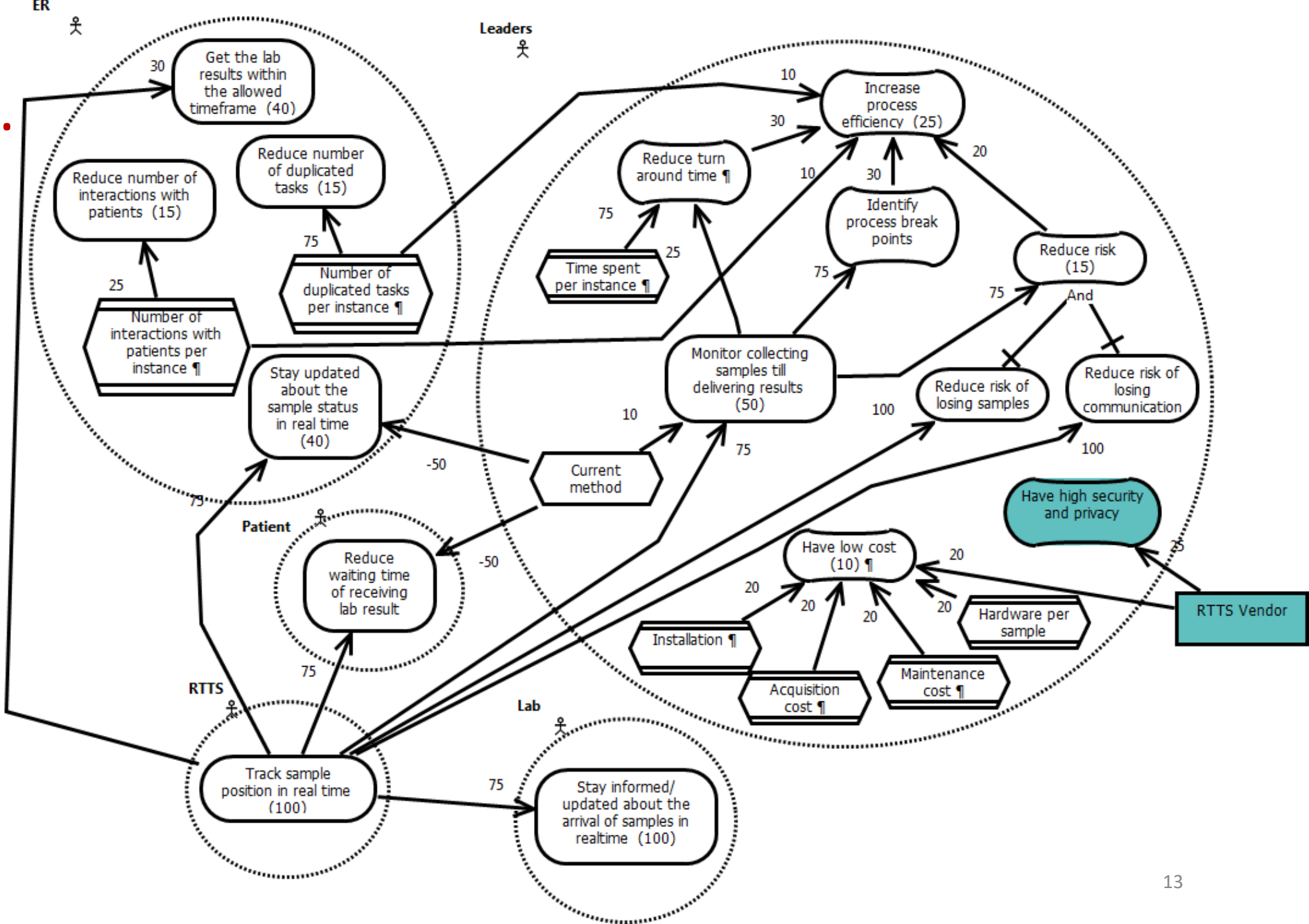




Proposed (to-be) RTTS-based process

Phase 1: Cont.

Goal model: built based on the values identified by the Lean team and by using the AbPI method



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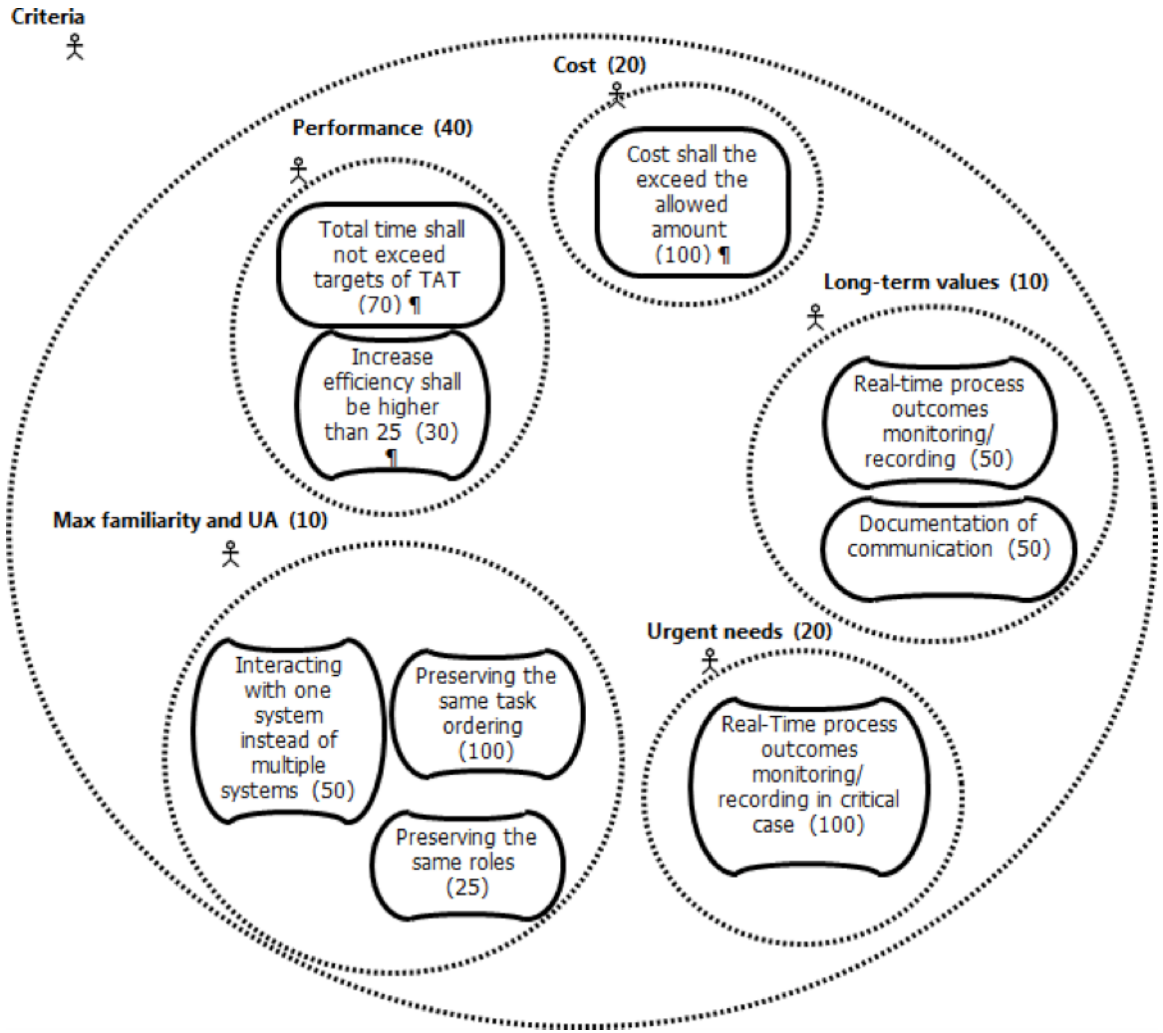
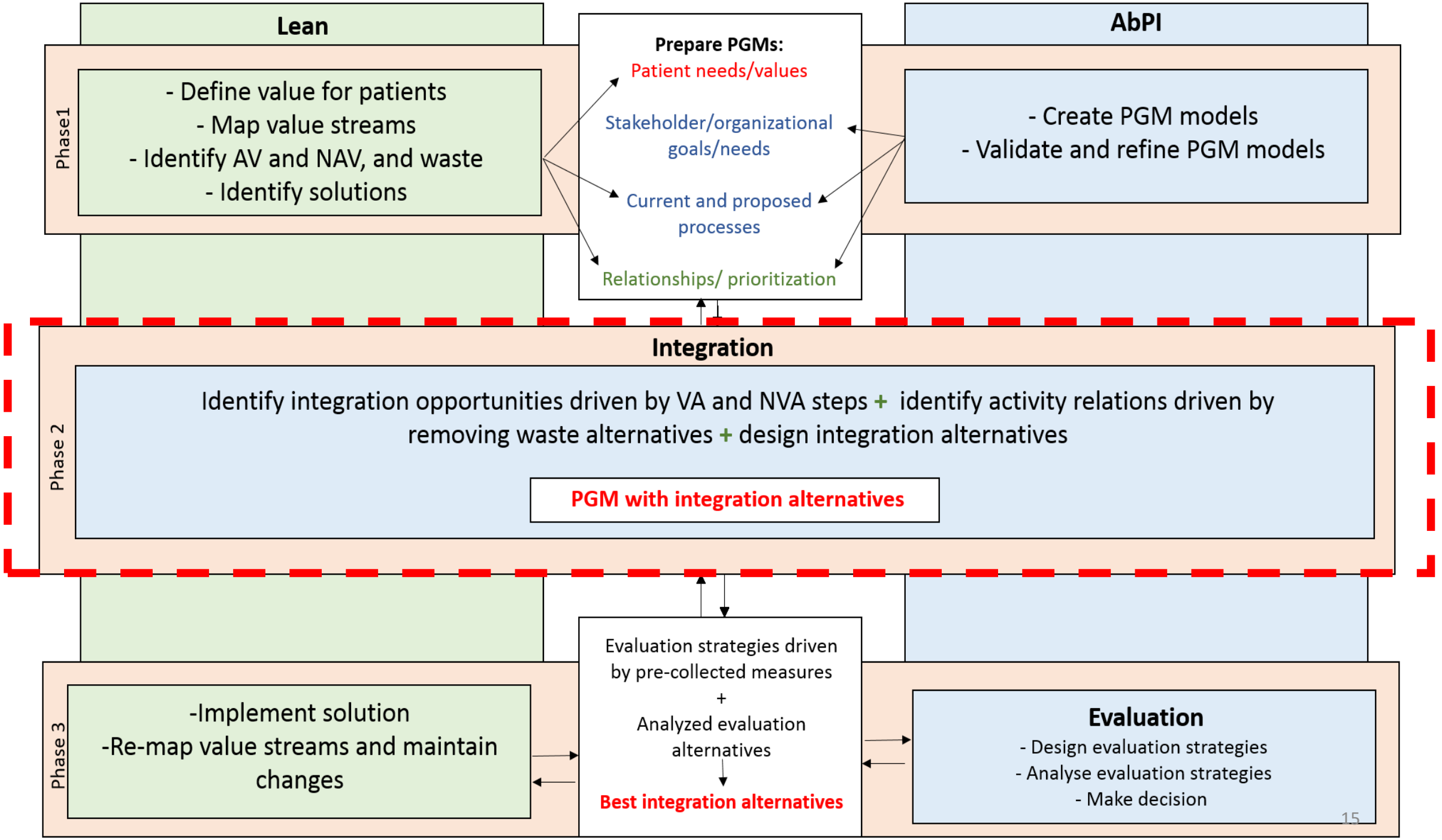


Criteria model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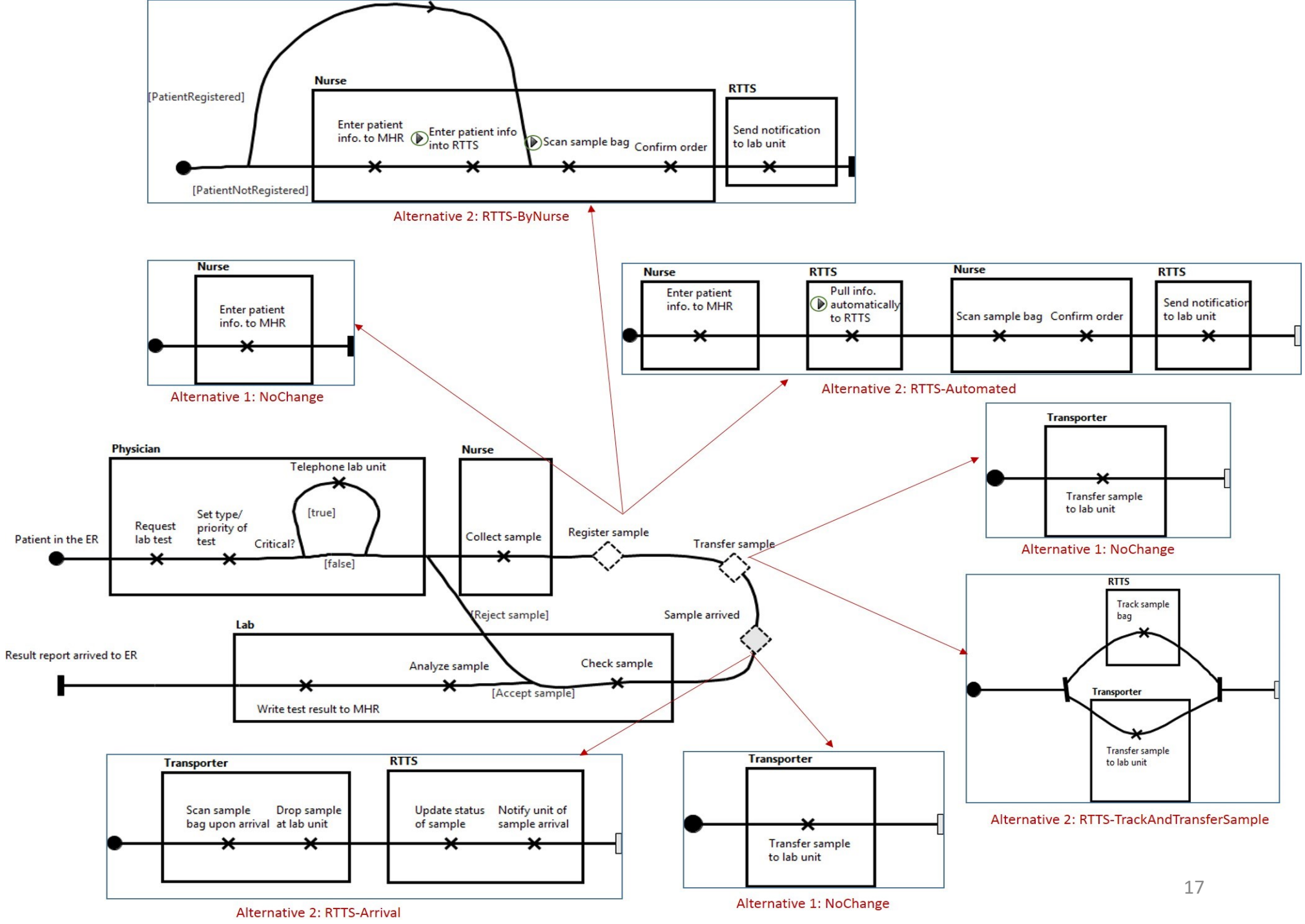
Phase 2: Integration

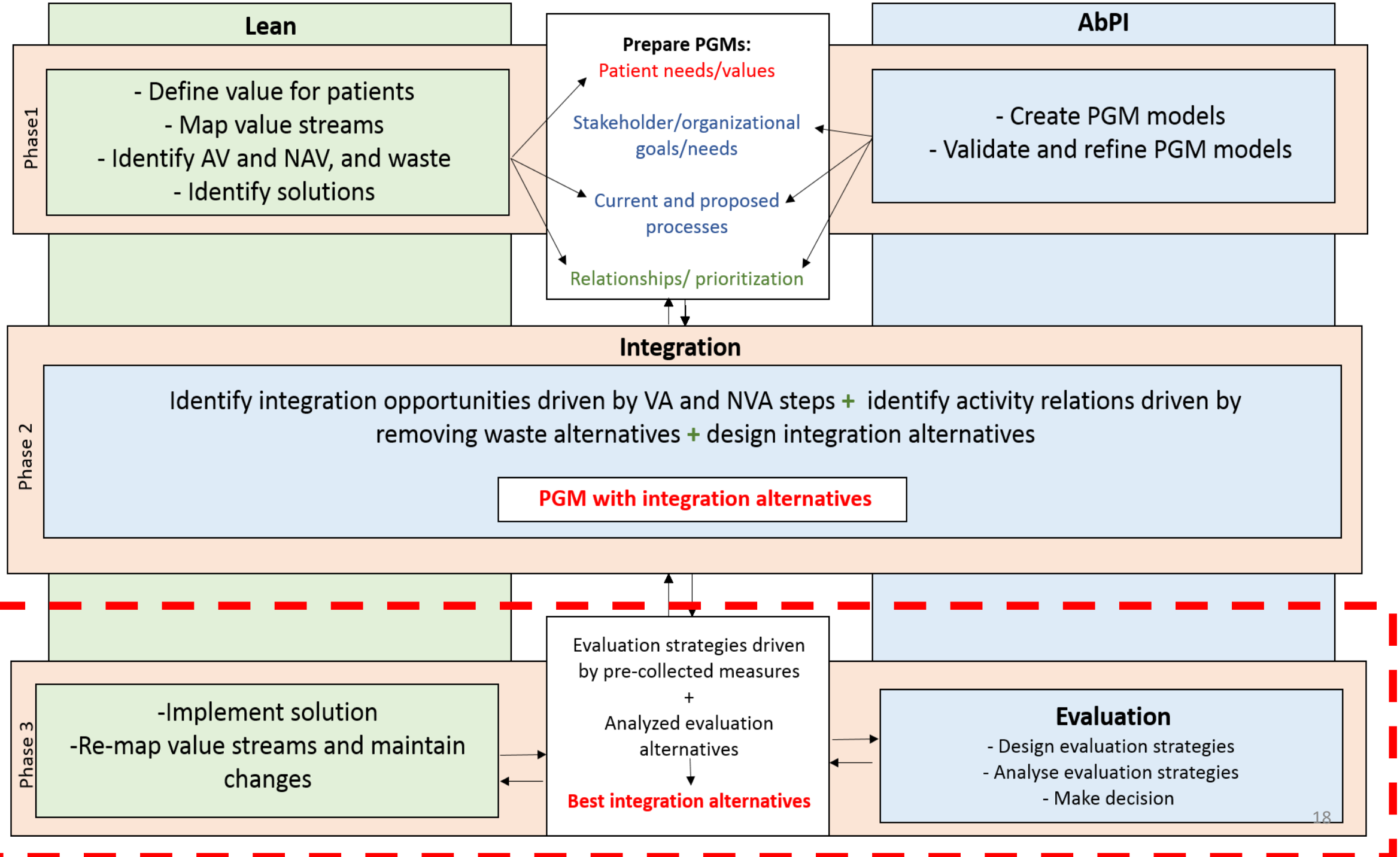
- There are two possible alternatives: ***RTTS-byNurse*** and ***RTTS-Automated***
- Non-added value and added value activities were identified by the Lean team while designing the alternatives
- RTTS-Automated was created to eliminate the waste in RTTS-byNurse (unnecessary duplicated tasks such as register patient twice)

TABLE I
FIRST TWO STEPS IN THE PROCESS INTEGRATION METHOD: IDENTIFYING INTEGRATION OPPORTUNITIES AND ACTIVITY RELATIONSHIPS

Activity to be integrated	**Integration opportunity**	**Activity-activity relation type**
Enter patient info into RTTS, byNurse	Enter patient info. into MHR	Combine, after
Enter patient info into RTTS, RTTS-Automated	Enter patient info. into MHR	Combine, after
Scan sample bag, Confirm order, Send notif. to lab unit	After Enter patient info into RTTS	Add
Transfer sample to lab unit	*Same*	*Same*
Scan sample bag upon arrival	Drop sample at lab unit	Combine, before
Update status of sample, Notify unit of sample arrival	Drop sample at lab unit	Combine, after

Process After Integration

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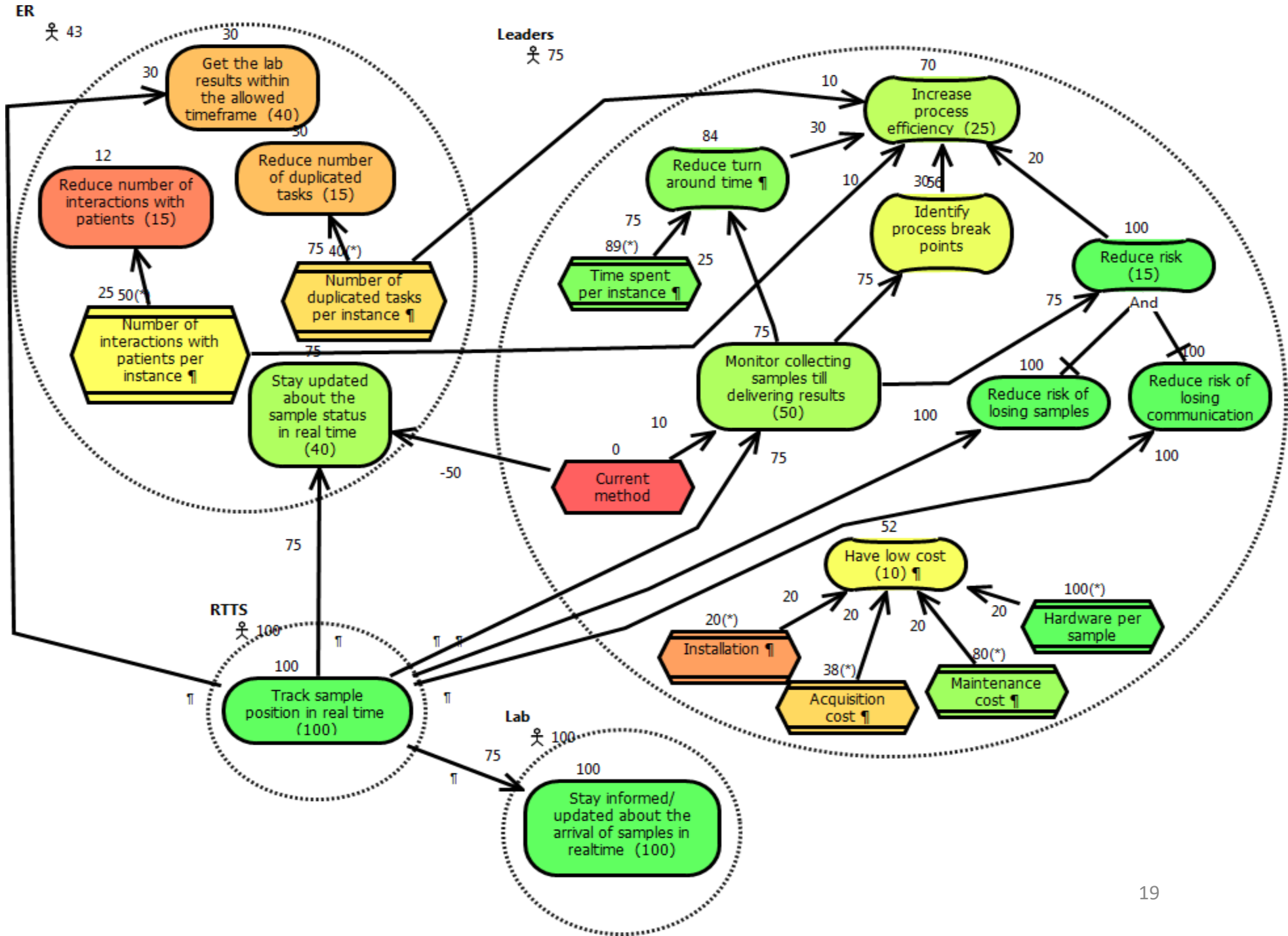
Phase 3: Evaluation and Implementation

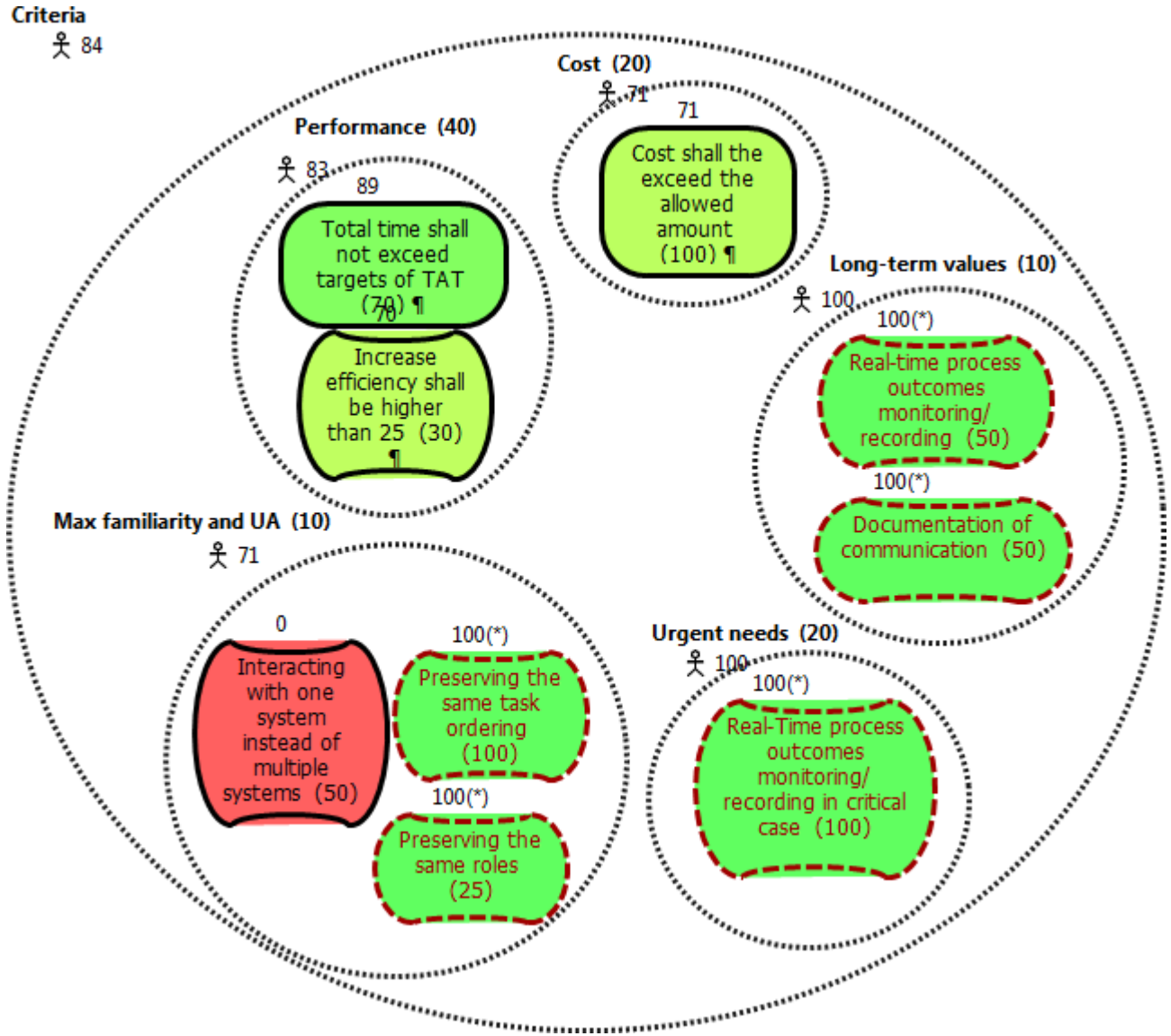
The RTTS-byNurse alternative in the Critical situation



Phase 3: Evaluation and Implementation

TABLE II
SATISFACTION VALUES ([0..100]) USING GRL STRATEGIES IN EACH ALTERNATIVE IN THE CRITICAL CONTEXT (A = ACTOR, G = GOAL)

Actors and Goals	By Nurse	Automated RTTS	Current Method
A:Patient	75	75	0
G:Reduce time of receiving lab result	75	75	0
A:Leaders	75	76	21
G:Increase process efficiency	70	76	23
G:Reduce turn around time	84	84	59
G:Identify process break points	56	56	7
G:Reduce risk	100	100	7
G:Monitor collecting samples till delivering results	75	75	10
G:Have low cost	52	46	100
A:ER	43	50	3
G:Get the lab results within the allowed timeframe	30	30	0
G:Reduce number of interactions with patients	12	12	0
G:Reduce number of duplicated tasks	30	75	22
G:Stay updated about the sample status in real time	75	75	0
A:Lab	100	100	0
G:Stay informed/updated about the arrival of samples in real time	100	100	0
G:Track sample position in real time	100	100	0



Evaluation of RTTS-byNurse in the Critical situation

Results

- The hospital has around 98,000 urgent cases and 558,000 routine cases yearly, increasing the cost of using an RTTS dramatically
- The RTTS system considered was developed by a single programmer:
  - The hospital would not pay much for it at the moment
  - RTTSbyNurse alternative was more welcomed than AutomatedRTTS
  - There is an issue with trust and potential threats to data privacy and system security if they go with the AutomatedRTTS alternative
- The hospital will use RTTS as a temporary solution to fulfill the urgent needs of critical cases while keeping the current method in the other (high-load) situations

Observations

- Goal models contained **more goals and stakeholders** that plain Lean, and helped stakeholders **disagree** early and then converge early towards a **shared understanding** of goals and their measures
- New concerns (e.g., security goals) appeared along the way, with a strong influence on the results
- The decision made (partial automation + partial deployment) was not even considered at the beginning, with Lean only
- Modeling tools for generic goal+process available (jUCMNav), but not entirely tailored towards Lean-AbPI
- Getting numbers for required indicators is still a challenge (but this was the case for Lean as well)

Conclusion

- New Lean-AbPI model that uses RE-based analysis methods with change management approaches to bring higher value and comprehensive coverage to the context of process improvement and integration
- The usefulness of the model was illustrated using a real-world case
- Discussing the model with healthcare partners highlighted weaknesses of plain Lean and the potential to adopt Lean-AbPI in practice
- More work is needed to further automate the analysis

Thank You!

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