RFID feasibility study
in the Hospital supply chain

End report

11 October 2006 - 9 February 2007

Ir. Th.C.G. Jeukens
Dr. Ir. S.L.J.M. De Leeuw

Agenda

- **Introduction**
- **Conclusions**
- **Methodology**
- **Summary of activities**
  - Supply chain analysis
  - Investigation of possibilities and potential of RFID
  - Design a supply chain based on prioritised application
  - Business case development
- **Justification of (re)sources**

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Introduction

- **RFID technology has a large potential and it is getting a lot of attention.**
- **At the same time the number of implementations beyond initial pilots remains low.**
- **Studies in the US show that RFID can be used successfully in the pharmaceutical industry.**

- **This feasibility study will search for answers how RFID can be used in the hospital supply chain in a sustainable business model.**

- **The study brings together four supply chain partners to design an integral supply chain for RFID applications and capture the results in a business case:**
  - The supplier of medical products
  - The supplier of packaging material inclusive of RFID tag
  - The supplier of ICT components to read/ write & interface RFID tag information
  - The hospital as user of medical products and supplier of medical care

- **The study is sponsored by NV Industriebank LIOF under the i-Zone cluster project.**

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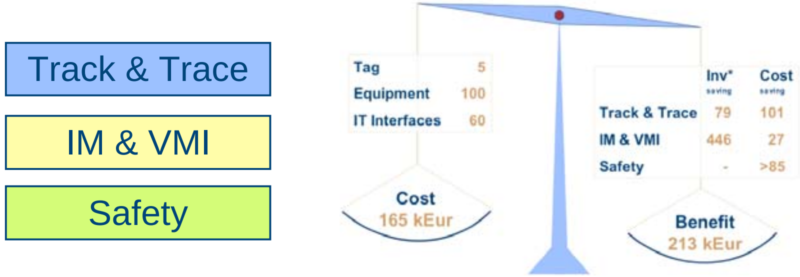
RFID can be introduced in the hospital supply chain in a sustainable business model when the following aspects are taken into account:

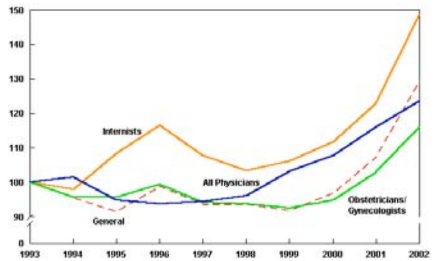
1. **The successful implementation of RFID in the hospital supply chain require use in at least 2 business application areas.**



2. **The RFID application must address more than only the (traditional) logistics usage (I). The supply chain must extend towards the patient (II).**

3. **Getting buy-in requires the combined effort of multiple KPI owners across multiple hospital supply chain partners.**

4. **Introducing liability cost will propel the introduction of RFID (and other techniques).**



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1. The successful implementation of RFID in the hospital supply chain require use in at least 2 business application areas.

- **No benefit of a single application in a single** organisation will offset the cost of RFID implementation.**

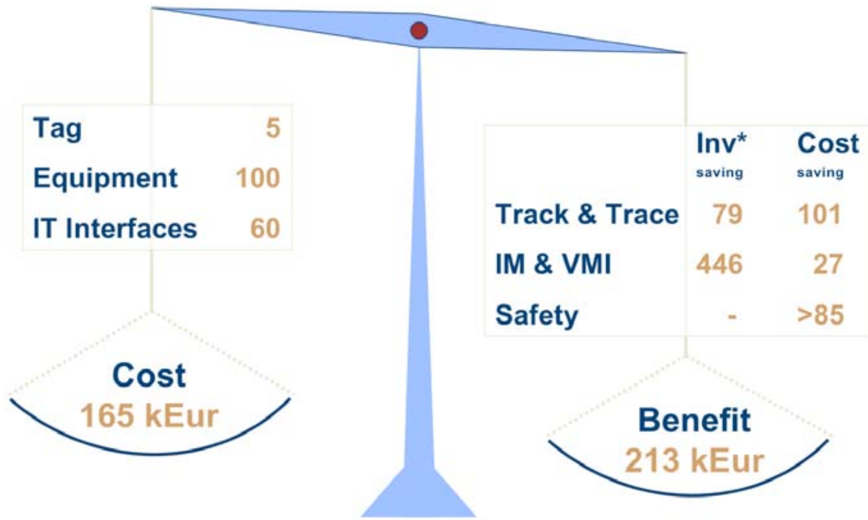
- **Inventory savings may tip the scale for a single partner in the supply chain, but the inventory will end up elsewhere and generate cost.**

- **Liability cost have the potential of tipping the scale for safety only. This is not expected on short notice in the Netherlands.**

Track & Trace

Inventory Management & VMI

Safety & patient individualisation



*) Inventory savings are a direct reduction of assets. Depending on accounting practices these savings will translate into cost savings. E.g. Interest cost.
In the balance of the scale the inventory savings are left out of the equation.

**) Adding the savings of multiple RFID business applications AND when including the savings of all partners of the integral supply chain, the benefit will be more convincing than the current delta between 165 and 200.

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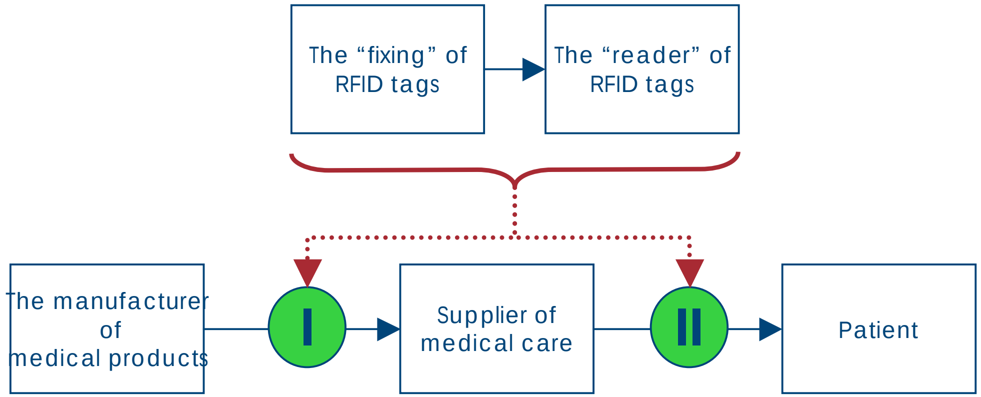
2. The RFID application must address more than only the (traditional) logistics usage. The supply chain must extend towards the patient.

– **A RFID tag is applied in the first part of the supply chain.**

– **When using this tag for logistics purposes related to the first (I) part only of the supply chain, it will be an expensive alternative to barcoding.**

– **When reusing the same tag for safety and patient individualisation purposes in the second (II) part of the supply chain, the combined benefits will outweigh the cost.**



3. Getting buy-in requires the combined effort of multiple KPI owners* across multiple hospital supply chain partners.

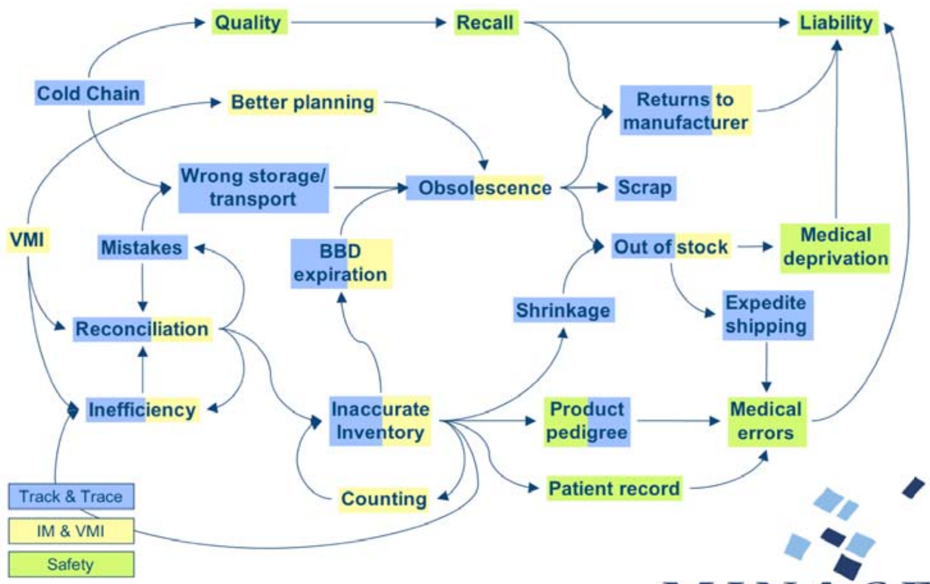
- **The cost and benefits of RFID are not equally spread** and balanced over all involved supply chain partners.**

- **When each function will have to decide individually on the introduction of RFID, it is not likely an implementation will follow.**

- **RFID creates a lot of opportunities, but it also requires a new agreed equilibrium amongst the partners.**

- **An decision is needed from all combined perspective of all involved partners.**

	Benefit	Description	Effect on	Reduct.	Value (kEur)	
					Inv.	Cost
Driver	Reconciliation	Due to the fact that many parties are involved in the exchange of medical products, differences and mistakes will require reconciliation.	Handling cost	-15%		16,5
Driver	Shrinkage	The effect of products being "lost" due to record inaccuracies, theft and misusage.	Inventory cost	-7%	36,7	
Driver	Out of Stock	The situation that no products are available for use. Out of stock has many causes and has significant impacts.	Expediting cost	indirect		
Driver	Obsolescence	The fact of having products in stock which are not usable anymore. Either because something is wrong with the product or because one had an incorrect planning.	Returns & Scrap	-15%		12,4
Driver	Operational efficiency	Looking at ways to reduce redundant operations, reduction of labour cost and reduction of manual operations.	Manual labour	-90%		45,0
Issue	Returns	The effect of returning products to the manufacturer caused by obsolescence or recalls.	Handling cost	-10%		11,0
Issue	Cold Chain	Certain medical products require special storage conditions, e.g. Cold chain for vaccines. Non compliance will lead to obsolescence.	Obsolescence	indirect		
Issue	Expedite shipping	As a result of not having the required products, emergency shipments will be required, incurring a lot of cost and disturbances to the regular way of working.	Expediting cost	-60%		16,5
Issue	Mistakes	Mistakes occur as a result of (too) complex process definitions and confusing application of technology (malice excluded)	Reconciliation & efficiency	indirect		
Issue	Scrap	If obsolete products can not be returned to and salvaged from the manufacturer, scrap is the last and most costly option.	Inventory cost	-10%	52,5	



*) KPI owner is the function/ person in an organisation that is responsible for a specific KPII.
**) The cost are predominantly generated by the packaging and ICT provider, whereas the savings mostly occur in the hospital and to a lesser extent at the supplier.

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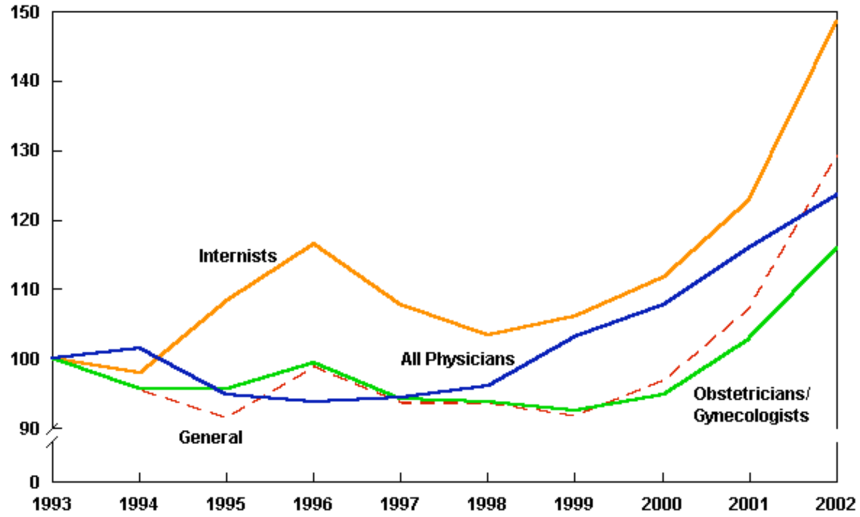
4. Introducing liability cost will propel the introduction of RFID.

- The potential of RFID technology addresses a lot of safety and individualisation benefits having moral, social and liability aspects.

- Moral and social benefits are difficult to quantify while on the other hand they have a clearly identifiable cost counterpart.

- Worldwide we see an increase in medical liabilities.

- We thus believe liability benefits must play an important role in the business case, leading to a propelling of the introduction of RFID (and other techniques).



Development of the liability cost* in the United States

*) Source: Congressional Budget Office based on data from the Office of the Actuary at the Centers for Medicare and Medicaid Services (data for all
physicians) and from annual premium surveys conducted by Medical Liability Monitor newsletter (data for physicians by specialty).

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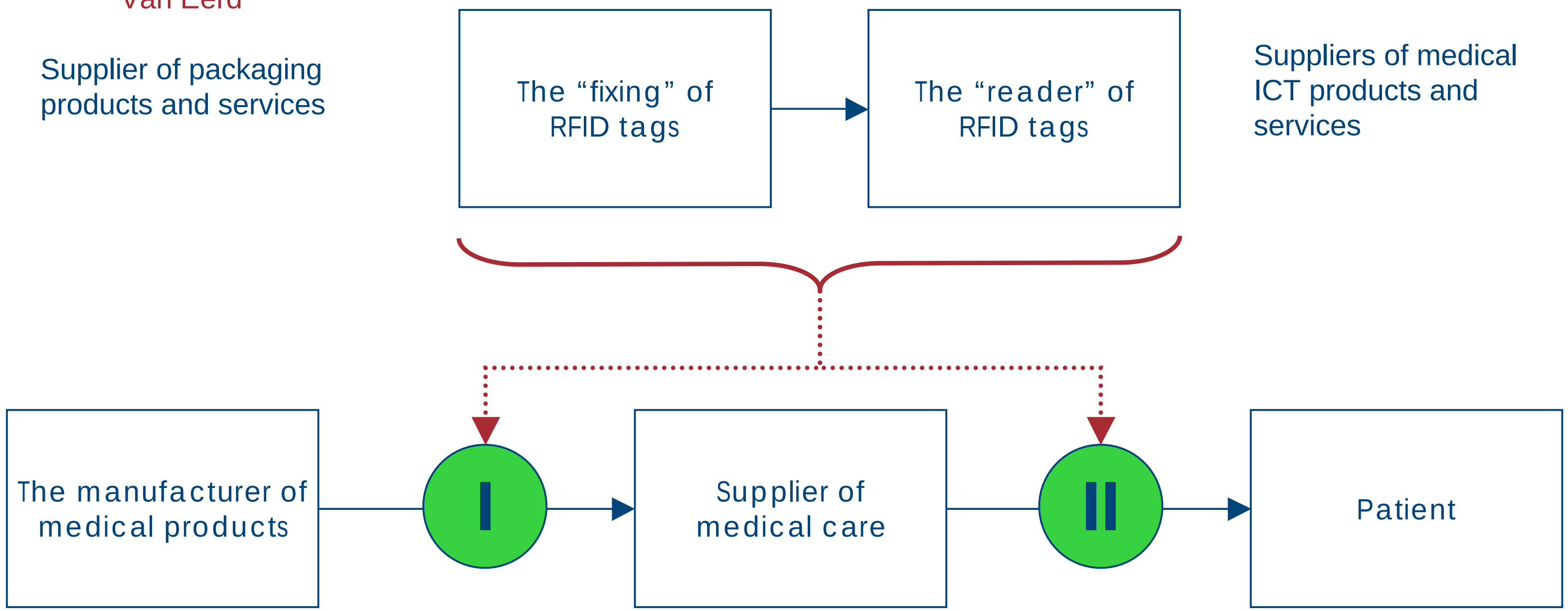
The study brings together 4 partners in the hospital supply chain.

Grafische Industrie Van Eerd

Supplier of packaging products and services

ECCT

Suppliers of medical ICT products and services



Johnson & Johnson

Supplier of medical products

Academisch Ziekenhuis Maastricht

User of medical products and services

Supplier of medical care

You & me

User of medical care

In a series of interviews and workshops we take an inventory of the situation, we learn from each other, we design an integrated supply chain and put figures to it.

Supply Chain analysis → **Possibility and potential of RFID Plus advantages** → **Business case development** → **Reporting**

2006

Week 41 - 45

Interviews:

- 11 October: Academisch Ziekenhuis Maastricht
    - Cees Neef
    - Axel Olislagers
- 18 October: Grafische Industrie Van Eerd
    - Roel van Eerd
    - Maarten-Jan Tacke
- 27 October: ECCT
    - Jos Geboers
- 7 November: Johnson & Johnson
    - Marco Verhoeven

Week 45 - 47

Workshop

- Determine boundaries of the supply chain
- Select product category
- Causal loop diagrams
- First step towards RFID supply chain design

Define “spin-off” Pilot

Week 48 - 5

Workshop

- Determine components of supply chain
- Define business case elements
    - Where are the costs
    - Where are the benefits
- Define data sources
- Establish lead KPI’s
- Define: who benefits what?
- Define model for cost/ benefit sharing

Week 6 - 7

2007

Workshop

- Complete business case
- Account for methodology
- Define Pilot
- Project potential & spin-offs
- Schedule mini symposium

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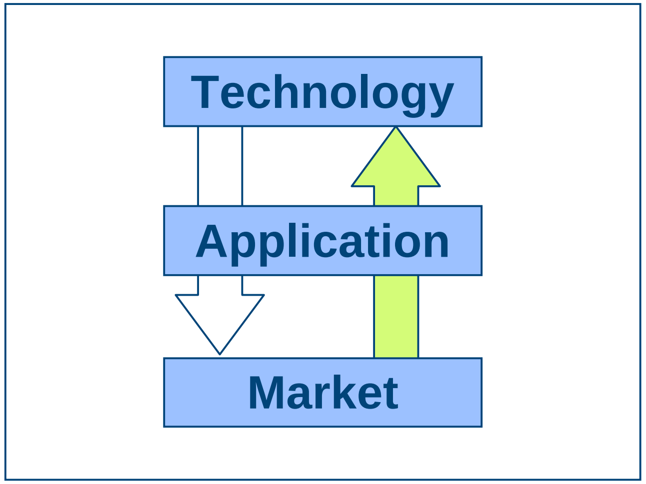
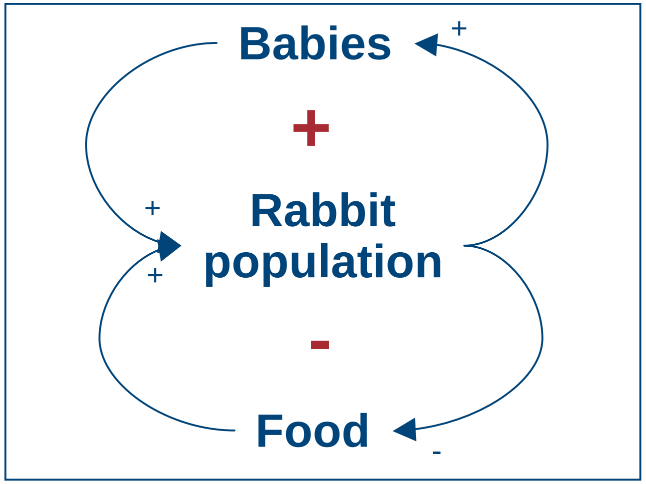
Zooming in on the potential of the use of RFID in the hospital chain

- In this feasibility study the potential of RFID is not driven by the technology capabilities but by the market pull.
- Merging the results of the interviews will signal a number of sweetspots.
- The supply chain partners will prioritise and select the applications that will be subject of potential investigation.



- Causal Loop Diagrams (CLD) are use to identify the potential and effect of the use of RFID in the sweetspot.
- The CLD will address all partners involved in the chosen application.
- The causal effect is be visible beyond the "boundaries" of a single partner.
- Identifying these will create new value proposition potential.



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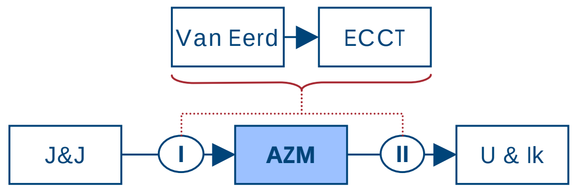
The supply chains of AZM



- **Multiple medical products with different characteristics flow through a hospital all having a different applications and thus in need of differentiated management and control.**

- **The hospital pharmacy control the supply chain of drugs**
- **The department procurement & logistics manages all other product categories:**
  - Bandages, aseptic gauze, syringes, gloves, plasters etc.
  - OR tooling like scalps, clamps etc.
  - Hospital furniture like beds, drawers, wheelchairs, infusion stand etc.
  - Textile like clothing and bed linen
  - Medical apparatus and instruments like scanners, respiration machines etc.
  - Medical prosthesis and other human “spare parts”.

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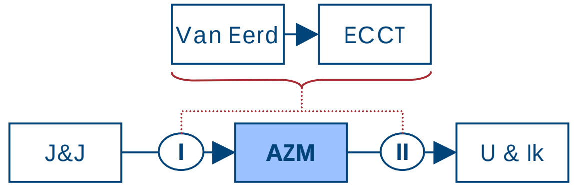
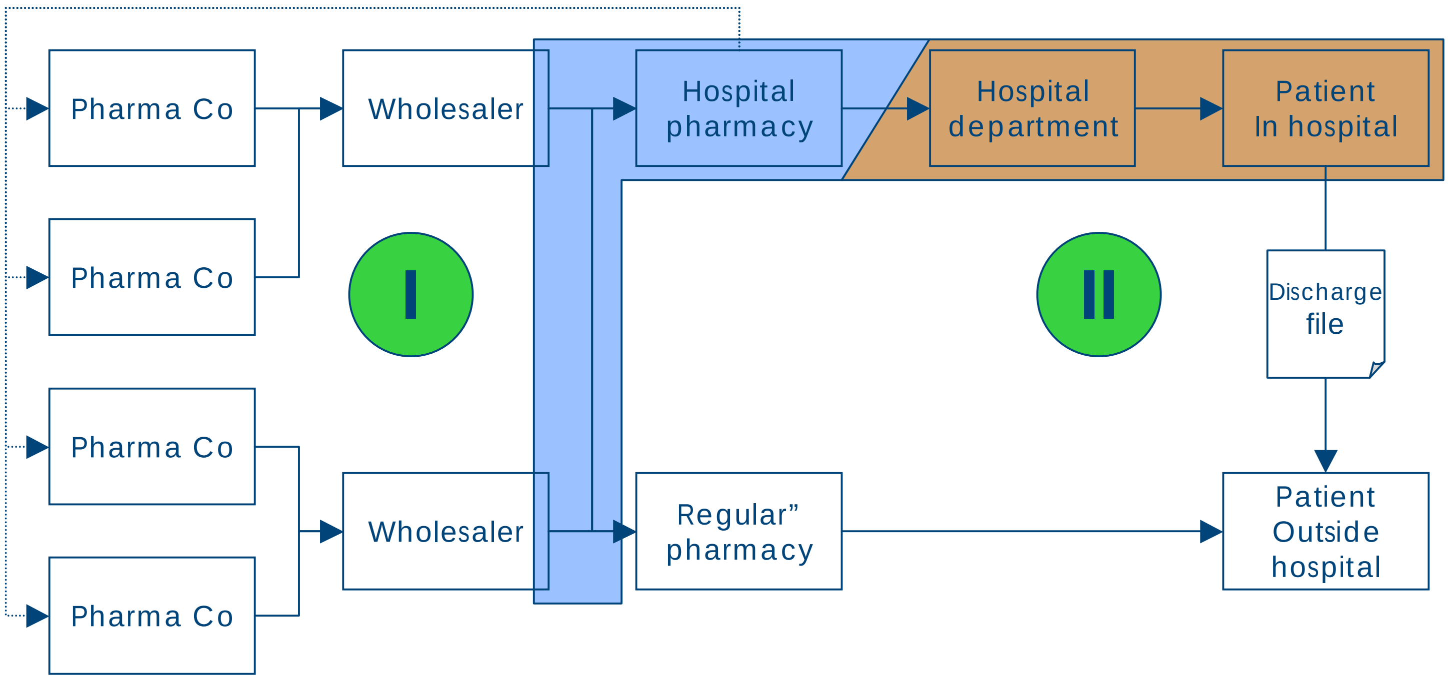
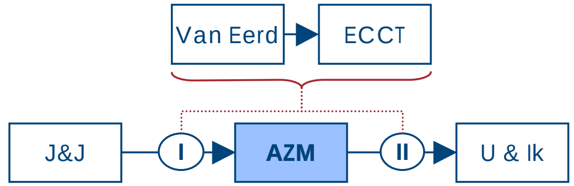


The drug-chain of AZM

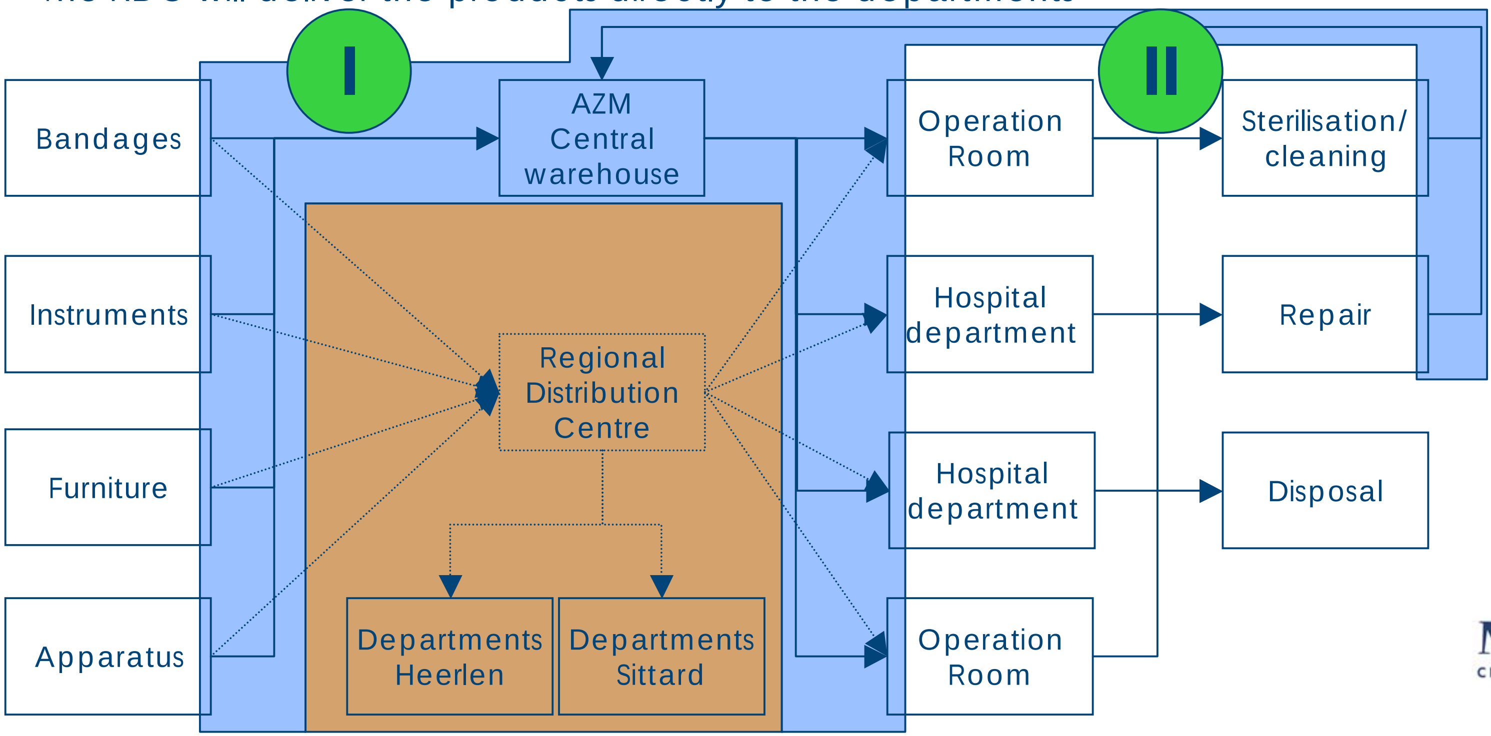
- **The hospital pharmacy controls the blue part of the drug chain (inside the hospital).**
  - The pharmacy makes commercial agreement with the pharmaceutical companies
  - The pharmacy orders from the wholesalers
  - The pharmacy receives the drugs, stores them and manages the Use-before-date
  - The pharmacy dispenses the drugs to the departments
- **The departments are responsible for the brown part of the drug chain inside the hospital**
  - The department “orders” the drugs from the central hospital pharmacy
  - The department manages the local department stock
  - The department applies the drugs to the patient



The procurement and logistics chain of AZM



- **Procurement & logistics control the supply chain for all non-drugs via means of a central warehouse.**
  - Medical products are procured directly from the manufacturer supplier
  - The products are delivered to the central hospital warehouse
  - Logistics manages the inventory and dispenses the products to the hospital departments
  - Some of the products have a reverse logistics loop
- **At the moment the hospital of Maastricht, Sittard and Heerlen are merging their procurement & logistics departments into a RDC.**
  - The RDC will have the combined procurement role
  - The RDC will deliver the products directly to the departments



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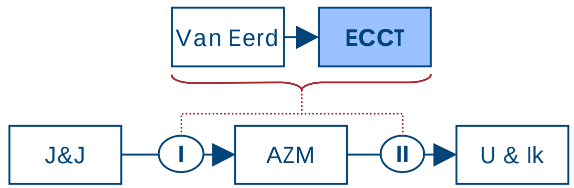
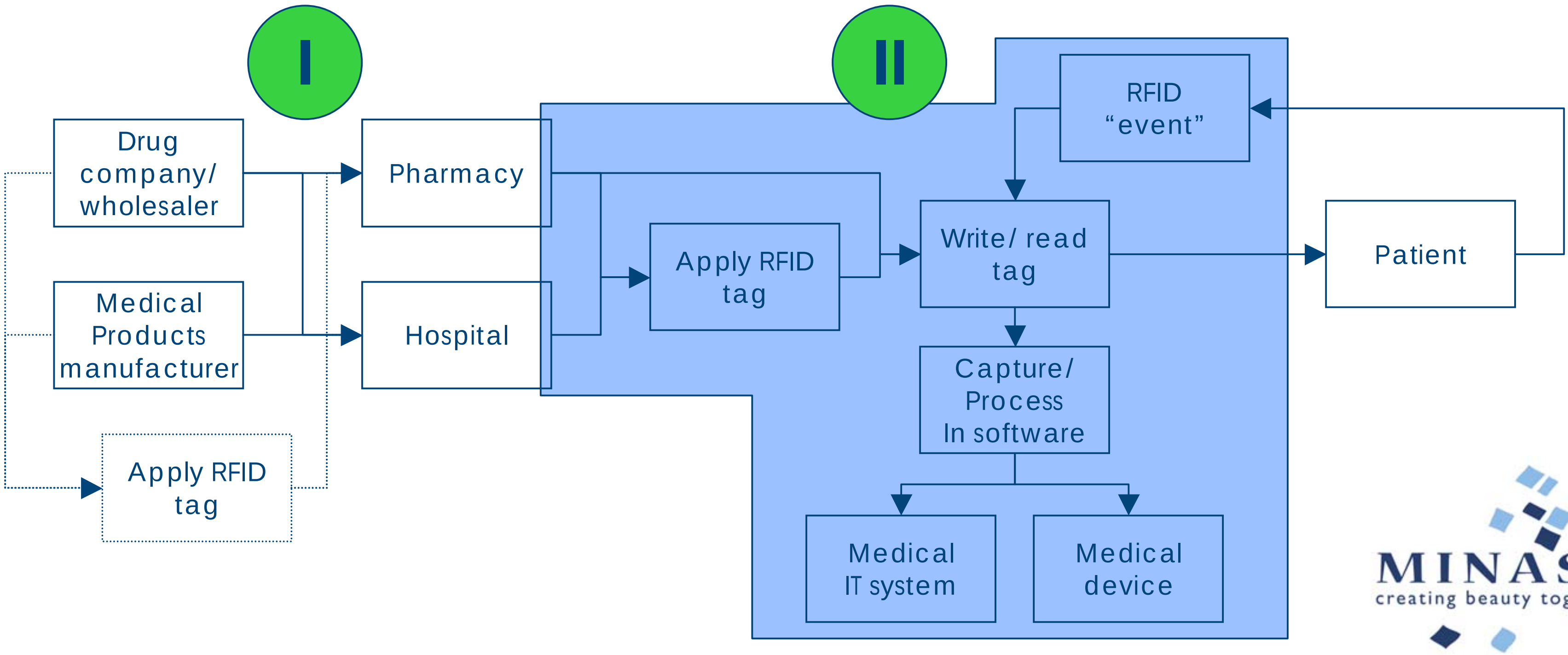
The supply chain of ECCT



- **ECCT predominantly operates in the second part of the medicine supply chain.**
  - Specific medicines are selected in conjunction with a hospital/ pharmacy
  - RFID tag is applied to the primary packaging of medicine
  - Tag is “fed” with information required for Therapy Loyalty use
  - Medicine is given to patient. Each “event” related to its use is stored on RFID chip
  - Patient returns empty primary packaging and tag is read. The information is fed to follow-up systems
- **Scalability to the first part of the medicine supply chain.**
  - Depending on volume, scale and combined usage, the application of the tag may occur earlier in the supply chain
  - Re-use for “traditional” track & trace etc.



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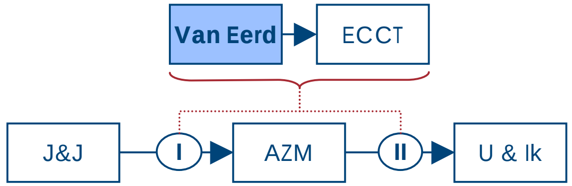
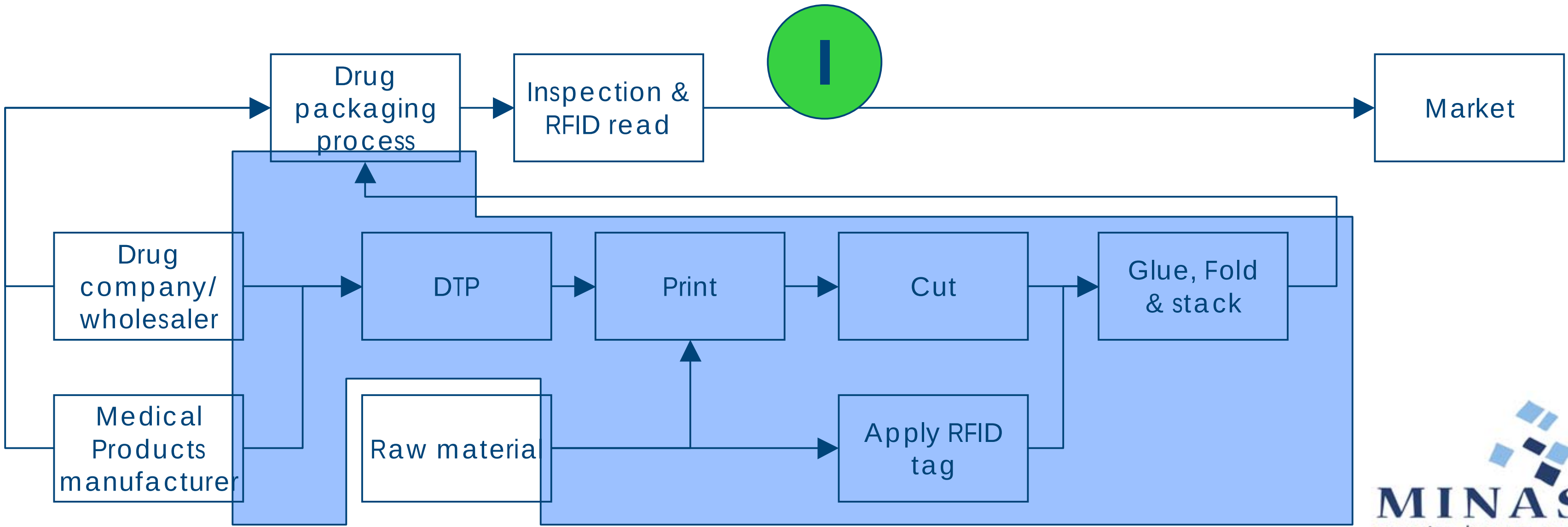


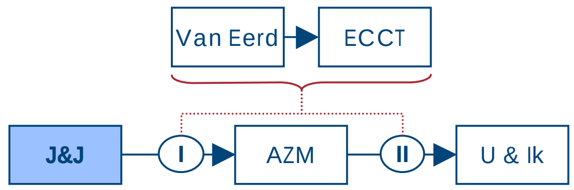
The supply chain of Van Eerd

– **Van Eerd predominantly operates in the first part of the medicine supply chain.**
  - The drug company drives the (secondary) packaging design
  - Van Eerd manufactures the packaging from graphic design, prepress, printing, die-cutting, gluing, pre-folding and stacking. In the process Van Eerd can apply a RFID tag as an integral part of the packaging.
  - The drug company inserts the stack of empty packages into the last stage of their packaging process, fills them with drugs and closes the box.
  - As a final inspection step the tagged boxes will be read.

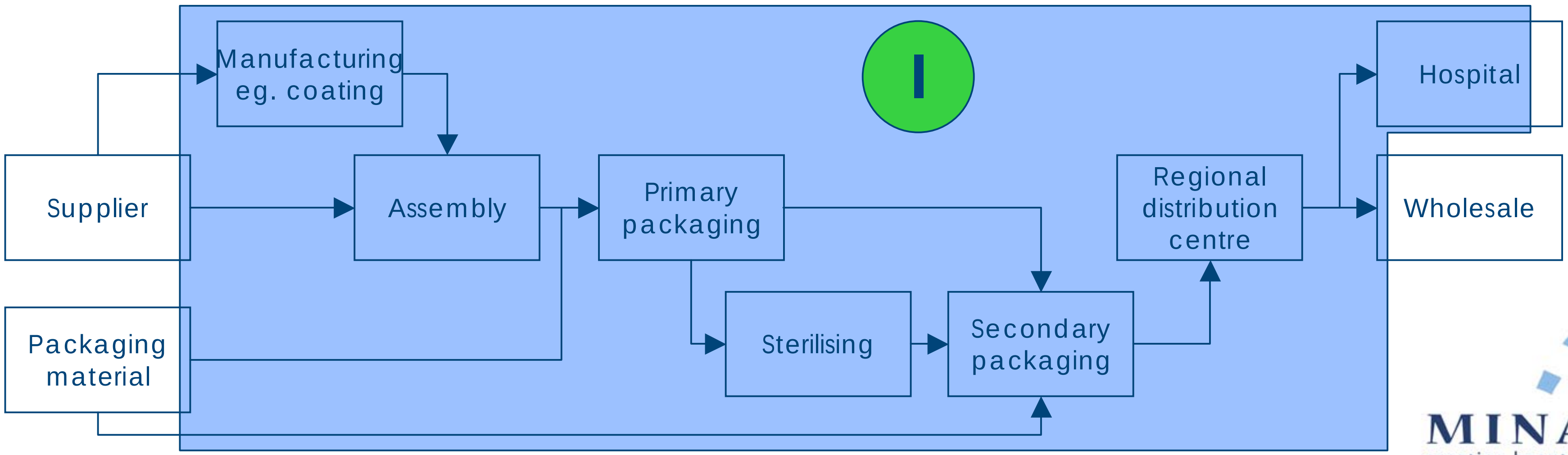
– **Pending legislation will require the tag to be applied to the primary packaging.**
  - Either this will be incorporated in the manufacturing process (1)
  - Or re-packaging will be necessary in any of the two parts of the medicine supply chain.



The supply chain of Cordis, Johnson & Johnson



– **J&J Cordis operates in the first part of the medical supply chain.**
  - Medical devices are made of components supplied from highly specialised companies and/ or own manufacturing sites.
  - Assembly a primary packaging are done in a continuous process
  - In most case the semi finished product requires sterilising. The sterilised product is put into a secondary packaging
  - From the regional distribution centre 90% of the volumes are shipped directly to the hospitals, 10% to wholesale parties
  - The inventory medical devices in hospitals is 80% consigned and 20% owned by the hospital. In NL the hospitals own the inventory
  - Per geography the location of the supply chain parties may differ
  - When RFID is used in the supply chain, it is attached to the secondary packaging



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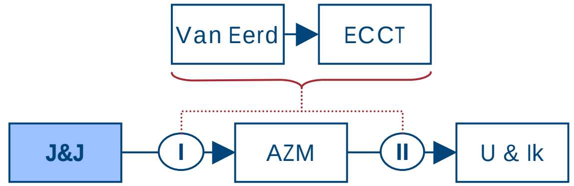
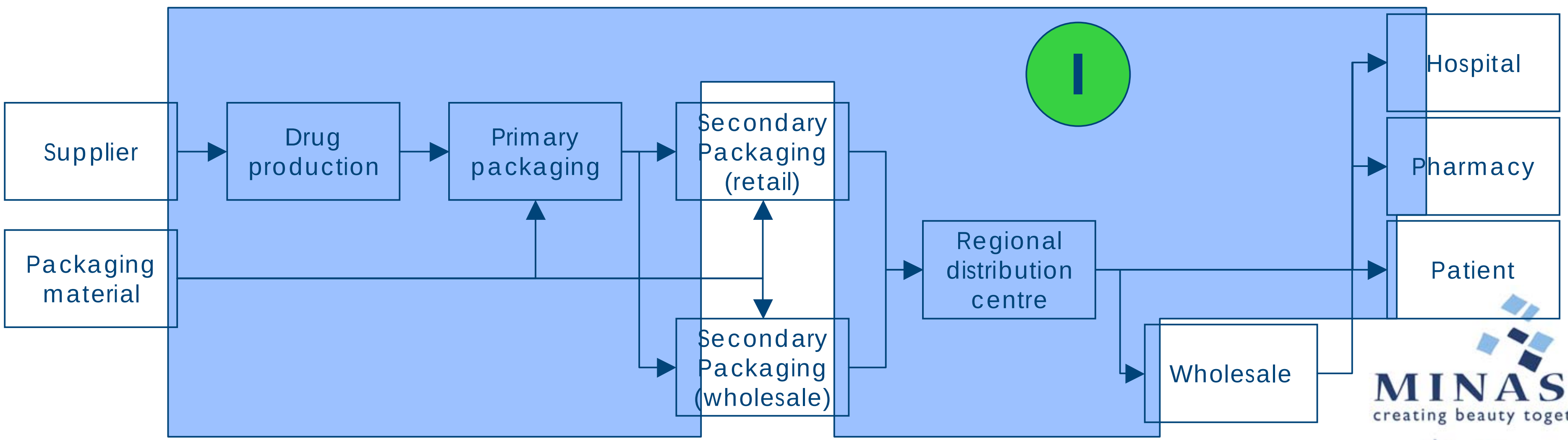
The supply chain of a drug manufacturer



- **A drug manufacturer operates in the first part of the medical supply chain.**
  - From raw materials the drugs are processed in a sterile and/ or acclimatised environment.
  - In a process flow the drug will put into its primary packaging. This may be a blister, ampoule or as simple as an environment-proof-coating.
  - The secondary packaging prepare the drugs for the destination supply chain. This step is often outsourced or partially managed by a specialised packaging company. This step may occur in the same process flow of the drug manufacturing or done off-site.
  - When RFID is used in the supply chain, it is attached to the secondary packaging
  - From a RDC the drugs are sent to a variety of “customers”
- **Generic versus patented drugs**
  - In case of patented drugs the secondary packaging is “retail” size. Multiple retail packages may be put in a bulk package.
  - In case of generic drugs the secondary packaging is “bulk” and/ or white label. The “retail” detailing happens in the second part of the medicine supply chain



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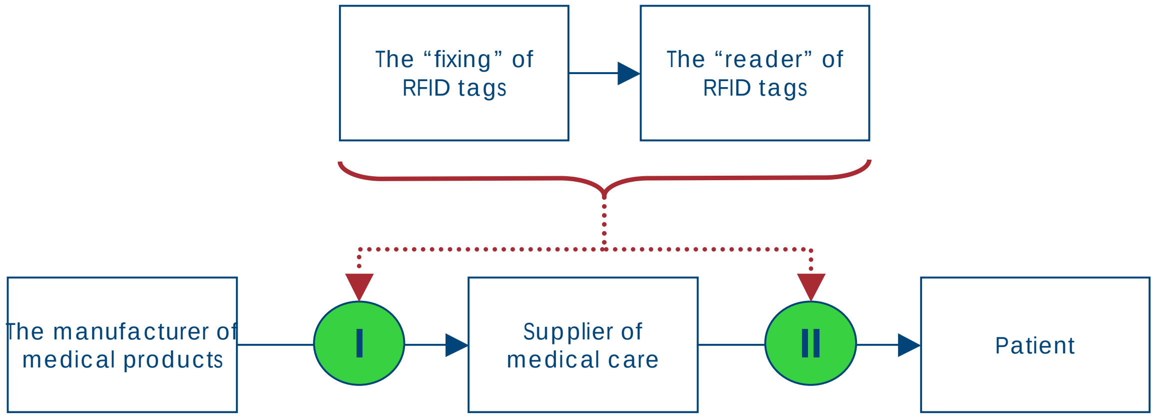
Mapping the products to the supply chain and the interest of involved supply chain partners, two sweetspots emerge.



	AZM	ECCT	vEerd	J&J	AZM	ECCT	vEerd	J&J	
Medicine									
▪ **Regular**	+	?	+	+	--	+	?	? / +	
▪ **Clinical trial**	+	+	+	+	+	+	+	? / +	1
Medical device	+	+	+	+	+	+	+	+	2
Medical supplies	+	+	? / +	+	-	+	? / +	? / +	
Medical equipment	+	+	na	?	na	na	na	na	

Sweet spot: Clinical trial

1

Use	Track & trace drugs from source to patient, monitor its application and feedback information to researcher.
Product	New drugs and/ or new treatment method
Supply chain	Manufacturer --> Hospital/ Pharmacy --> Patient --> (TeleMonitoring) --> Researcher
RFID	Apply tag in the production process of the drug manufacturer. Make tag “dual”use, such the same tag can be used to capture time of application.
Interest	
▪ **AZM**	Patient safety, most robust track & trace, reduction of manual data recording
▪ **ECCT**	Extending therapy loyalty with “traditional track & trace, tag-multi-use development
▪ **vEerd**	Developing RFID tag application expertise on primary, secondary packaging
▪ **J&J**	Full track & trace, raw demand data, treatment response data
Positives	• A clinical trial has separate funding/ additional budgets • Ethical and professional barriers are “interpreted” differently by all participants because they are willingly doing something new. • Acceptance to use new technologies • A clinical trial is a contained innovation and research domain
Negatives	• Clinical trials operate in a niche

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Sweet spot: Medical devices & supplies

2

Use	Track & trace devices and supplies from manufacturer to its use in the OR / hospital department. Until use the inventory will be owned and managed by the manufacturer based on the feedback from the t&t data.
Product	Medical devices and supplies
Supply chain	Manufacturer --> Hospital RDC --> Hospital department / OR --> Specialist
RFID	Apply tag in the production process of the device/ supplies manufacturer. Use RFID readers as close as possible to its actual use (based on ABC classification)
Interest	
▪ **AZM**	Off-balance inventory, supports RDC strategy, reduces investment in mgmt tools
▪ **ECCT**	Develop (handheld) read tools and software that interfaces with J&J and AZM sys
▪ **vEerd**	Developing RFID tag application expertise on primary, secondary packaging
▪ **J&J**	Full track & trace, raw demand data, mgmt of UBD, assist in inventory mgmt
Positives	• Hospital logistics departments are already familiar with RFID and consigned inventory, only not for this product category • The procurement and logistics department are on the doorstep of a conceptual change: product standardisation, procurement synergy, logistics outsourcing • Standardisation on identification, systems and processes create a window of opportunity to introduce RFID beyond logistics t&t
Negatives	• Does only affect the first part of the supply chain • Cost and singular supply chain will reduce the application to the more expensive products

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Finalising the interviews and merging the findings has led to a further detailing of the scope: Medical devices.

- **Based on the sweetspots and the preference of the partners, the choice is made to set the focus of the feasibility study to: Medical devices**
  - Less is known about the dynamics of the medical devices supply chain
  - Track & trace and patient safety are important
  - The supply chain does not “flow” via the (hospital) pharmacy
  - The chain provides numerous win-win elements beyond the traditional “in house” focus
- **Spin-off**
  - A pilot will be defined for the use of RFID in the Clinical Trail supply chain.
    - The supply chain analysis is complete
    - The definition of the supply chain is concrete
    - The business case elements are understood
    - The “mind set” in the Clinical Trial domain is “right”

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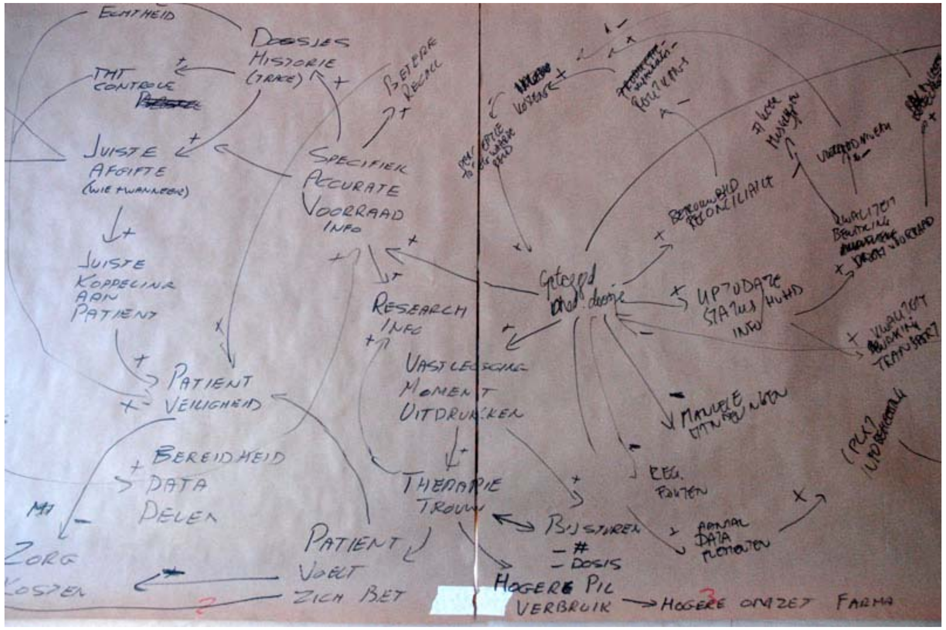
The potential and dynamics of RFID are mapped using cause-and-effect relations.

- **In order to present a more readable version of the diagrams, two views have been inserted in this report:**

- **The supply chain partner view**
  - Hospital (& patient)
  - Packaging supplier
  - ICT provider
  - (medical) product supplier
- **The application view**
  - Patient safety & individualisation
  - Reconciliation
  - Vendor Managed Inventory



Page 2 and 3 of 4 pages

- **To address the “why not” of RFID an extra diagram has been added addressing the powerful emotion called “resistance”.**

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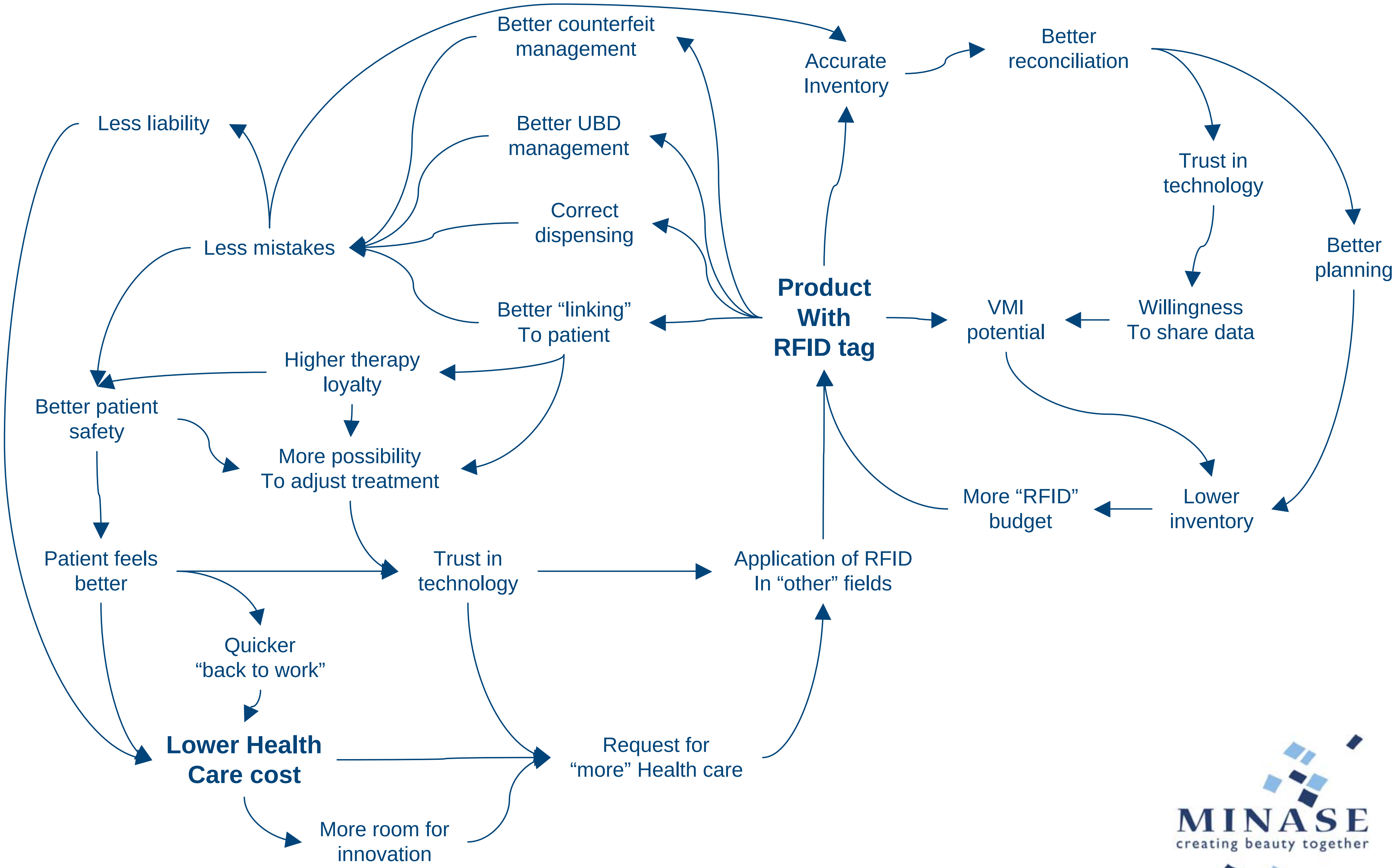
The benefits of RFID for the Patient & Hospital



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Supporting remarks to the diagram: Patient & Hospital

- **Characteristics:**
  - The patient is represented indirectly via the doctor/ specialist in the hospital.
  - Safety and wellbeing are the prime interests of the patient. Cost does play a role, but not in life threatening situations.
  - A doctor/ specialist is driven by the same variables, but also adds the element that the patient has to “obey” the treatment.
  - The hospital as institution is driven by patient safety, cost and liability.
- **Multi-use of RFID may be the linking pin for patient wellbeing & safety and the cost of HealthCare.**
- **Potential uses of RFID may increase the HealthCare cost as a whole.**
- **Not all benefits of RFID find its way into the current financing and insurance cost model.**
- **The value proposition of the Patient & Hospital is:**
  - Added value: the Patient & Hospital (as Client) are the receiver of the value proposition, but in returning data & information and accepting technology they are also the enabler of the proposition.
  - Added value: being loyal to your therapy increases the demand for pills and medical devices
  - Added value: embracing RFID (and TeleCare) technology, increases the demand for Care and Prevent (ref: Cure)
  - Cost: being loyal to your therapy reduces the integral Health Care Cost
  - Cost: better management of the inventory and adoption of VMI reduces the cost.

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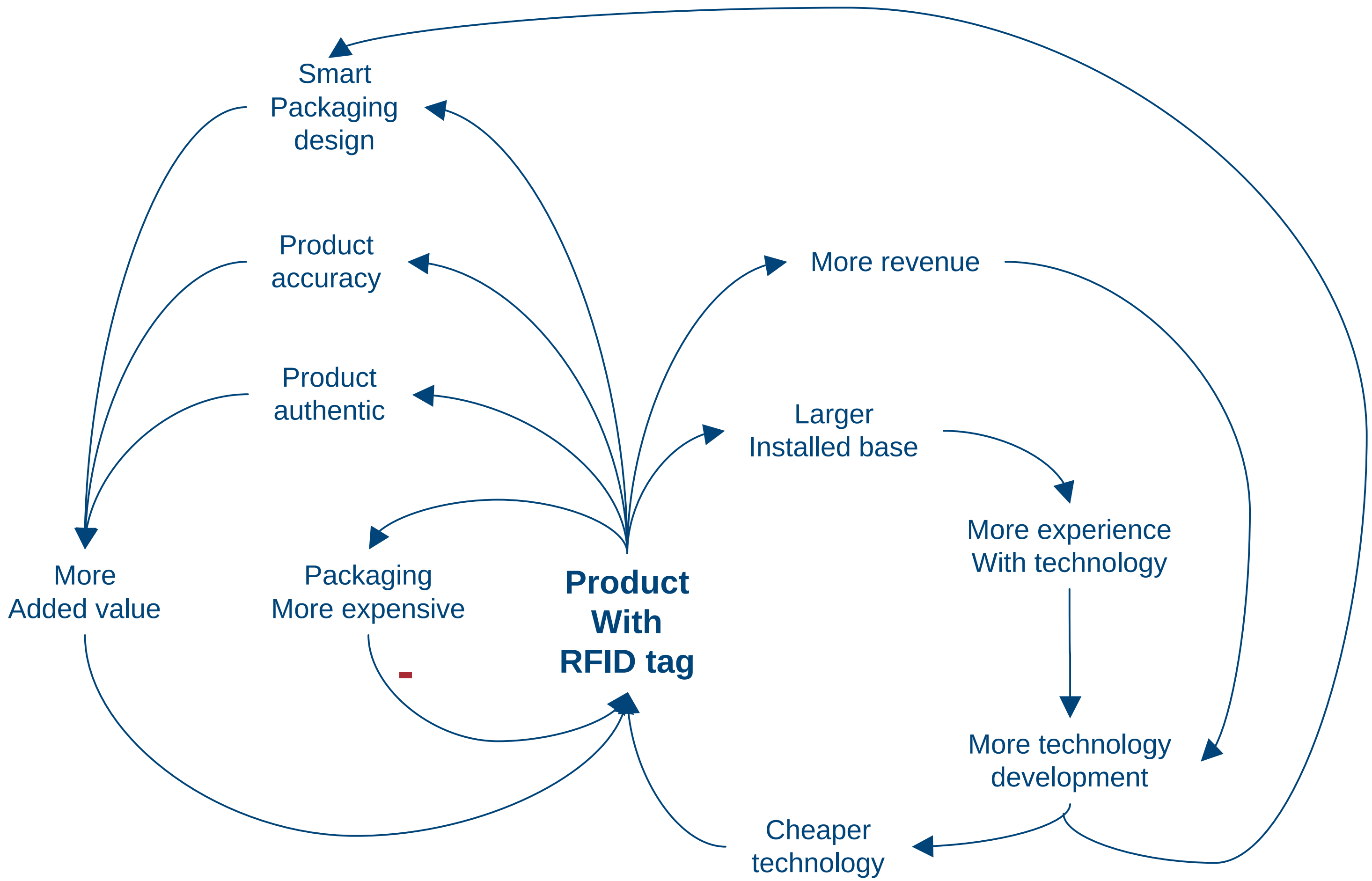
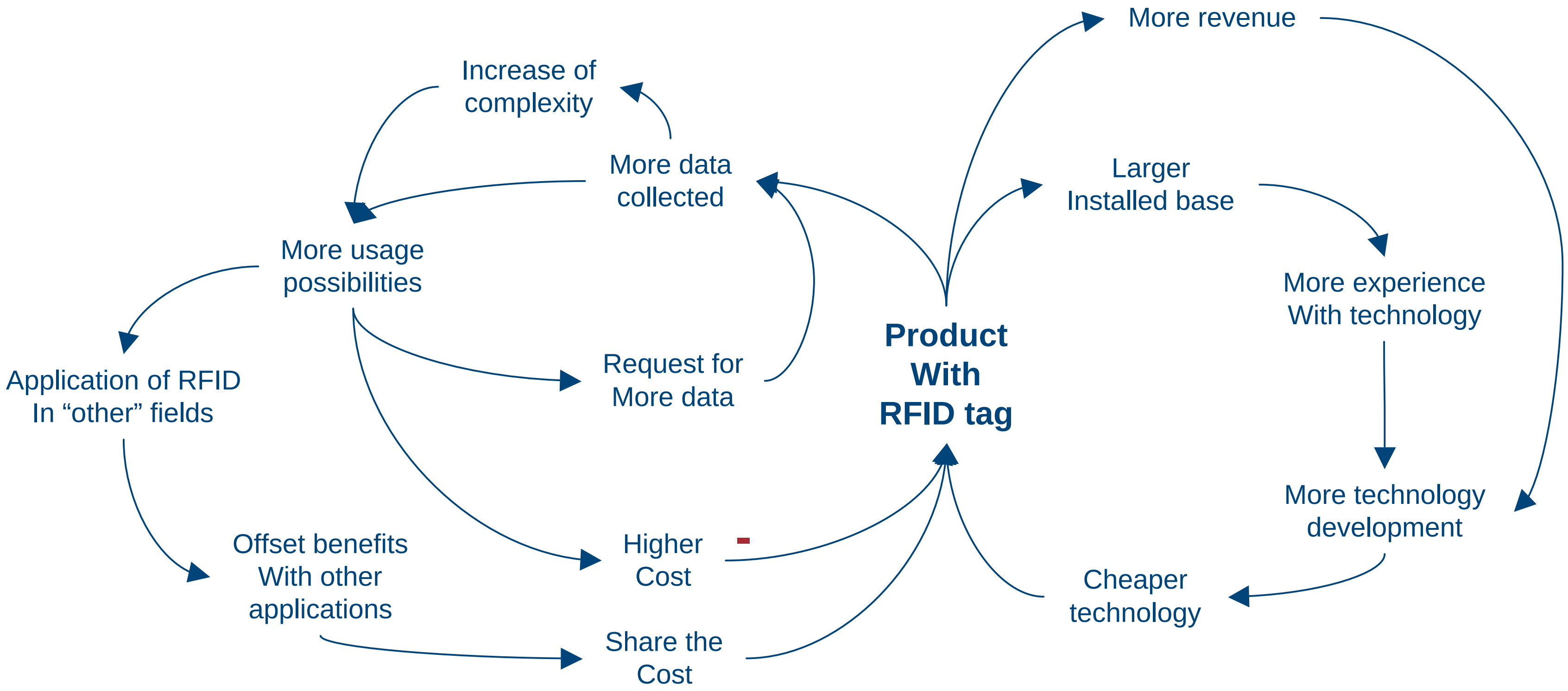
The RFID value proposition of the Packaging supplier



Supporting remarks to the diagram: Packaging supplier

- **Characteristics:**
  - For medical devices the RFID tag will be applied to the package of the device.
  - In most cases this will be the secondary packaging. In the future this may shift to the primary package due to (FDA) regulations.
  - The packaging supplier will attach the RFID tag to the (secondary) package and these will be supplied to the medical device manufacturer.
  - The Medical device manufacturer will use the packaging material in its process flow.
  - Upon outbound the tag will be written and read.
- **Using RFID will increase the price of packaging compared to the current package without tag.**
- **The value proposition of the packaging supplier is:**
  - Added value: enable the medical device manufacturer to capitalise on the additional functionality of the package
  - Cost: obtain economies of scale such that the cost per packaging unit decreases.
  - Combination: smart packaging design

The RFID value proposition of the ICT provider



Supporting remarks to the diagram: ICT provider

- **Characteristics:**
  - At various locations in the supply chain the RFID tag has to be read/ written.
  - Some of these locations are stationary, others are mobile.
  - Some data can be read from the tag and is self explanatory, other data is “only” a reference to additional information in the IT system.
  - The ICT requirements will be driven by the process agreements between the medical device manufacturer and the hospital ... And their willingness to share data.
- **Using RFID will increase the ICT cost (initially)**
- **Availability of RFID will increase the demand for additional data and uses.**
- **The value proposition of the ICT is:**
  - Added value: enable the medical device manufacturer and hospital to capitalise on the additional functionality of RFID
  - Cost: obtain economies of scale such that the cost of technology goes down.
  - Combination: use RFID such that it combines uses, such that it offset the initial higher cost: e.g. Combine track & trace with VMI concept of track & trace with therapy loyalty.

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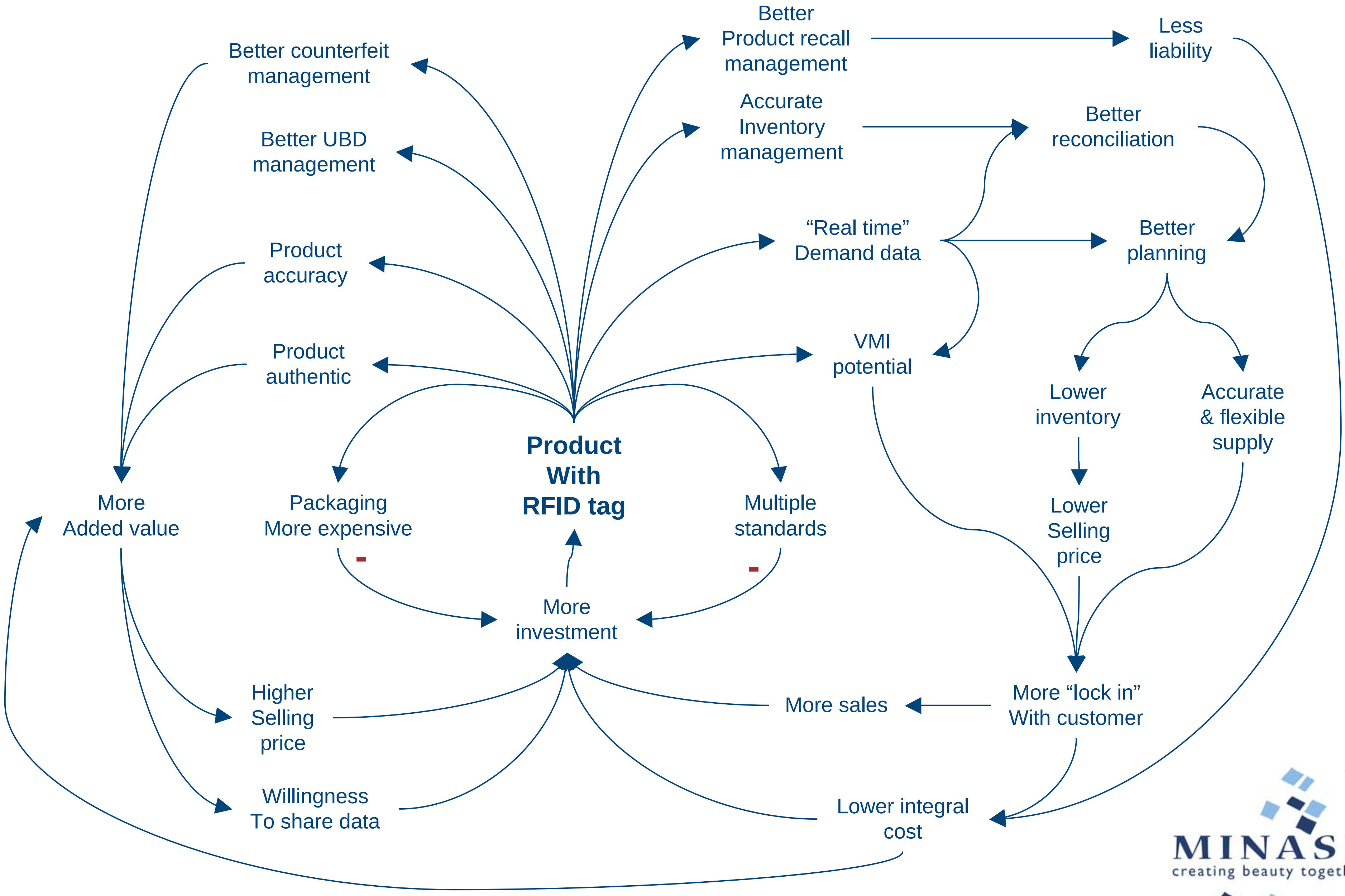
The RFID value proposition of the "Product" supplier



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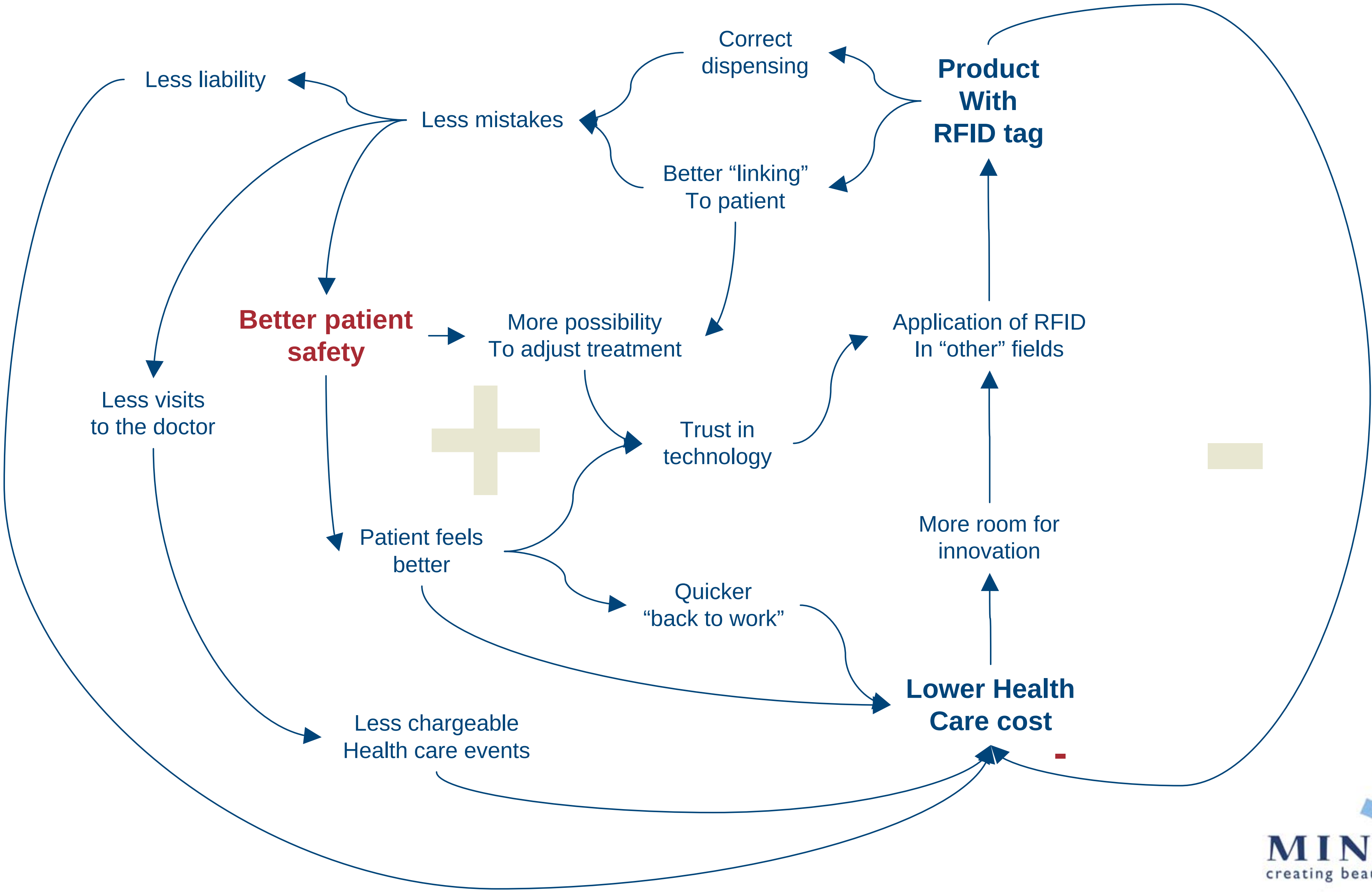
Supporting remarks to the diagram: “Product” supplier

- **Characteristics:**
  - Applying RFID tags to products is not core to a manufacturer of medical devices, but it is a responsibility to provide means of safety.
  - Packaging is treated as Cost, but a medical devices manufacturer wants to offer additional/ value added services in order to lock-in the customer and to safeguard future revenue.
  - A manufacturer is hesitant in starting with RFID due to the absence of agreement on standards.
- **Using RFID will increase the ICT cost (initially)**
- **Multiple standards are confusing (to both supplier and buyer)**
- **Supplier/ manufacturer needs new commercial models to capitalise on the new capabilities of RFID (think beyond the traditional boundaries)**
- **The value proposition of the “Product” supplier is:**
  - Added value: take over functions of the hospital: planning, inventory management
  - Added value: more flexibility and accuracy in delivery due to data sharing
  - Added value: more revenue due to therapy loyalty facilitation
  - Cost: availability of better demand data enables more efficient planning
  - Cost: less loss due to diversion and counterfeiting
  - Combination: VMI - additional lock-in, data sharing and economies of scale

Application view: The Patient Safety & individualisation loop



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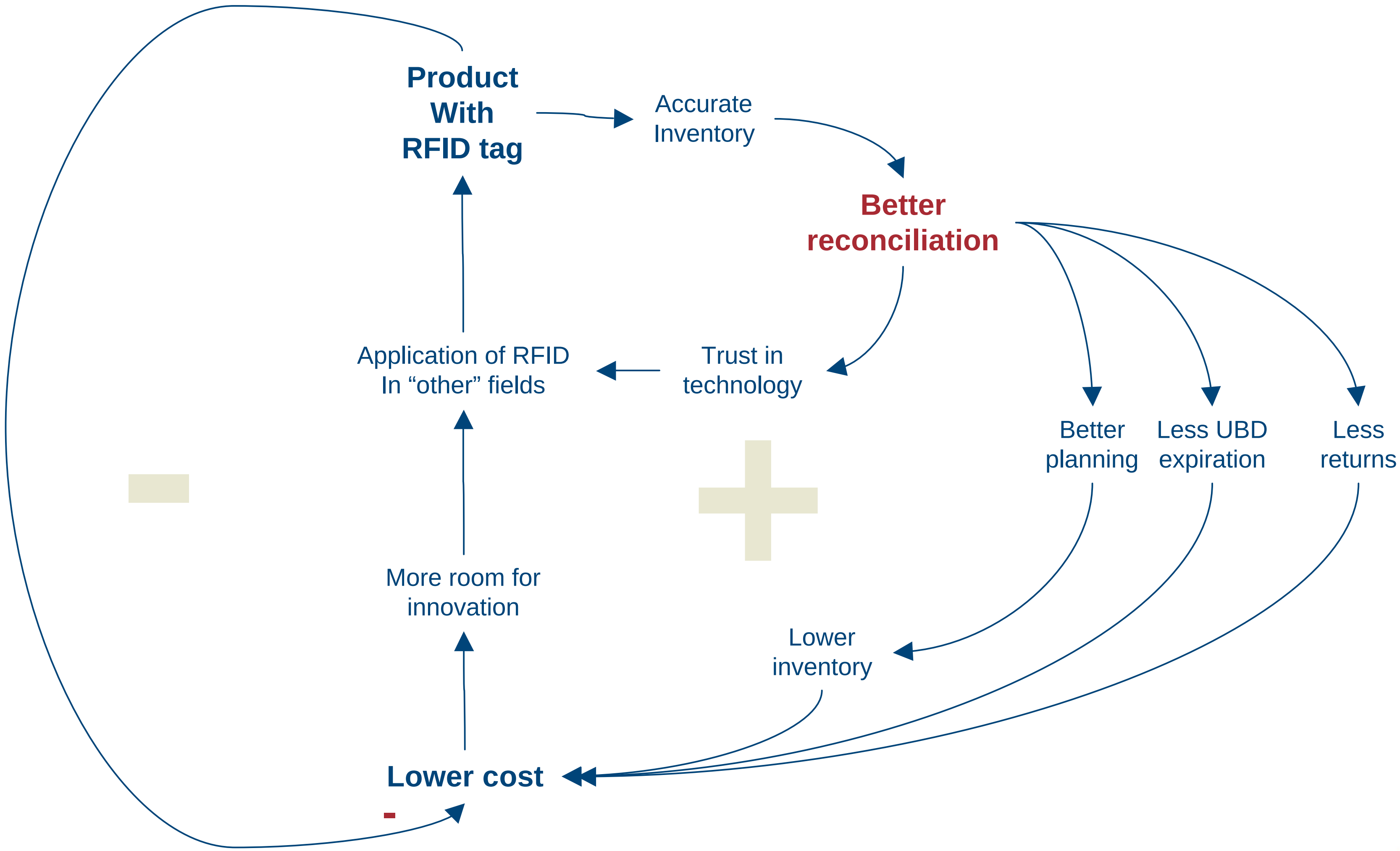
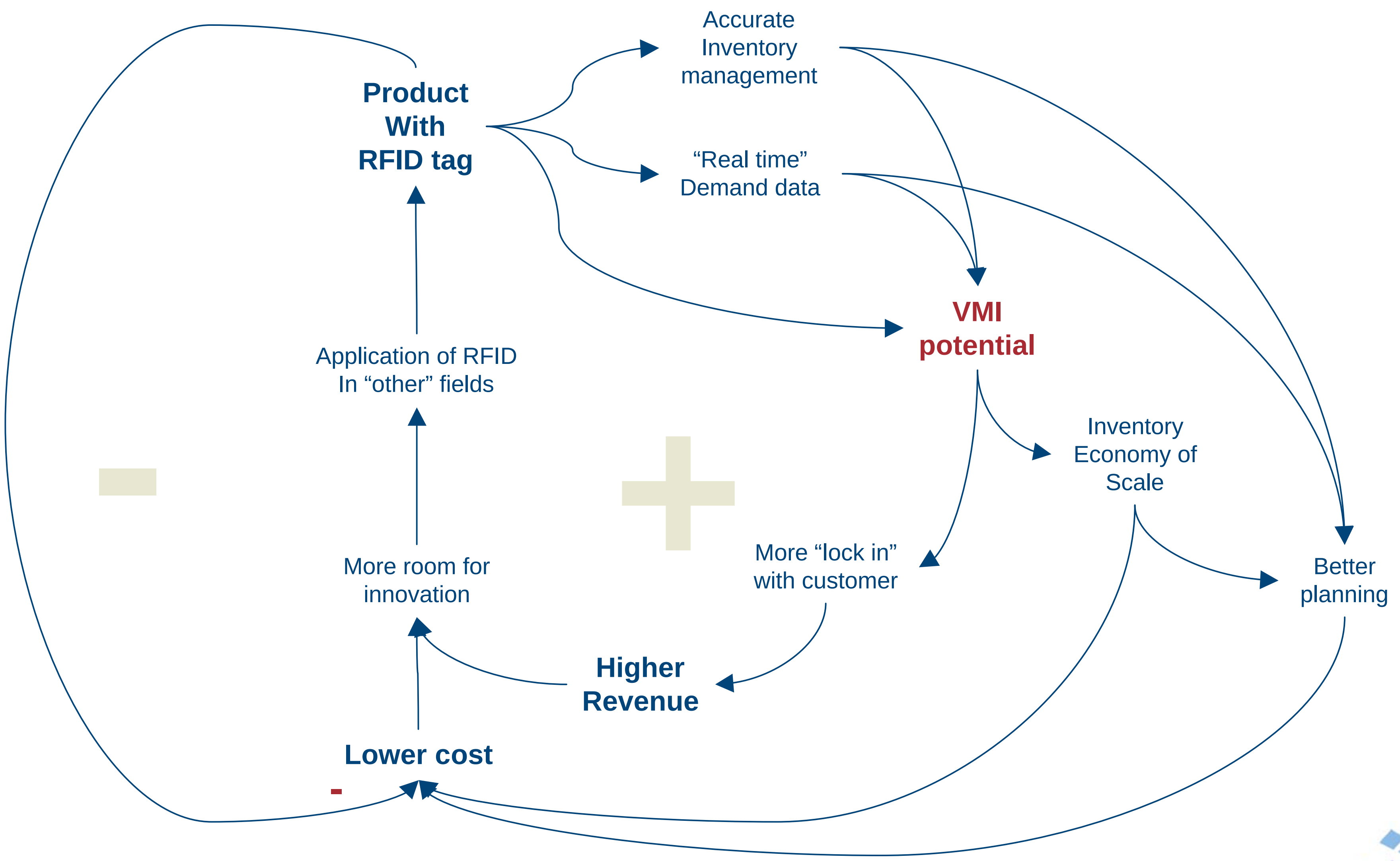
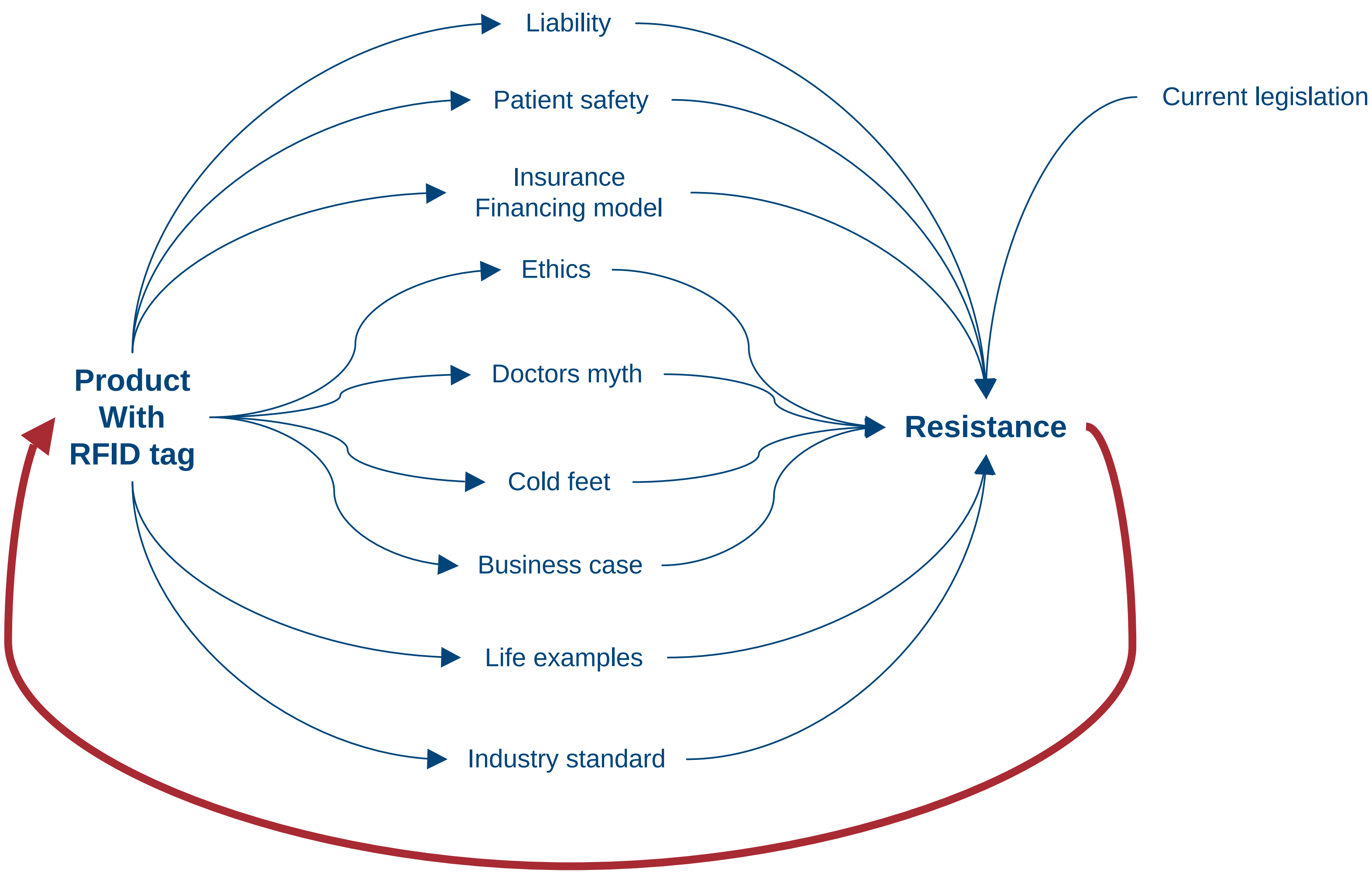
Application view: The Reconciliation loop



Application view: The Vendor Managed Inventory loop



The RFID negative - Resistance
Catch 22



There are many variables that enforce or negate resistance.

There is no single & simple loop.

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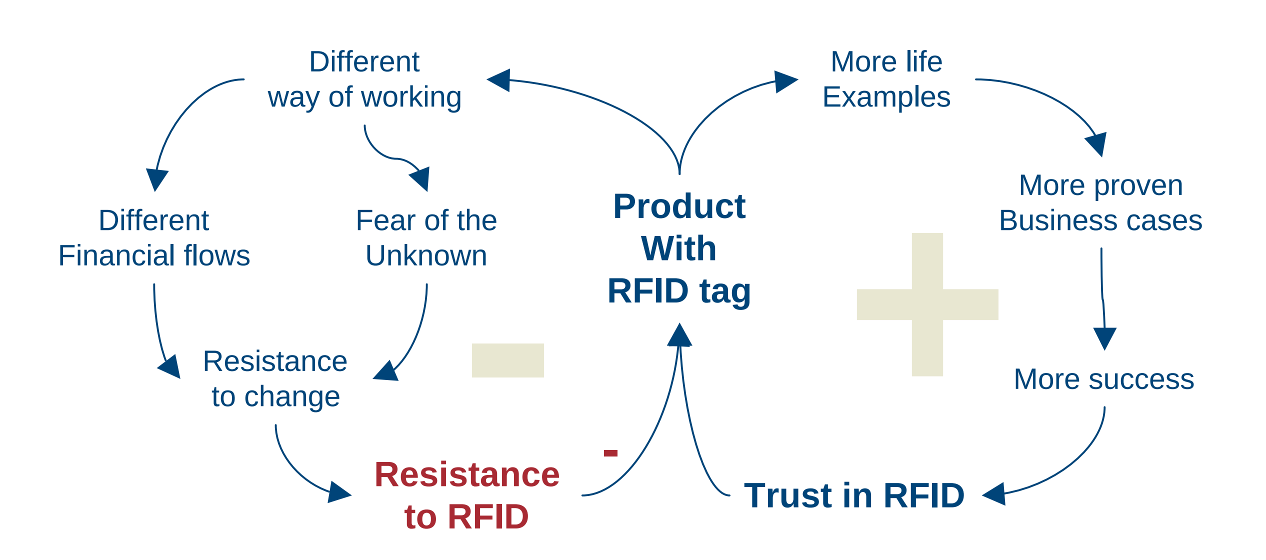
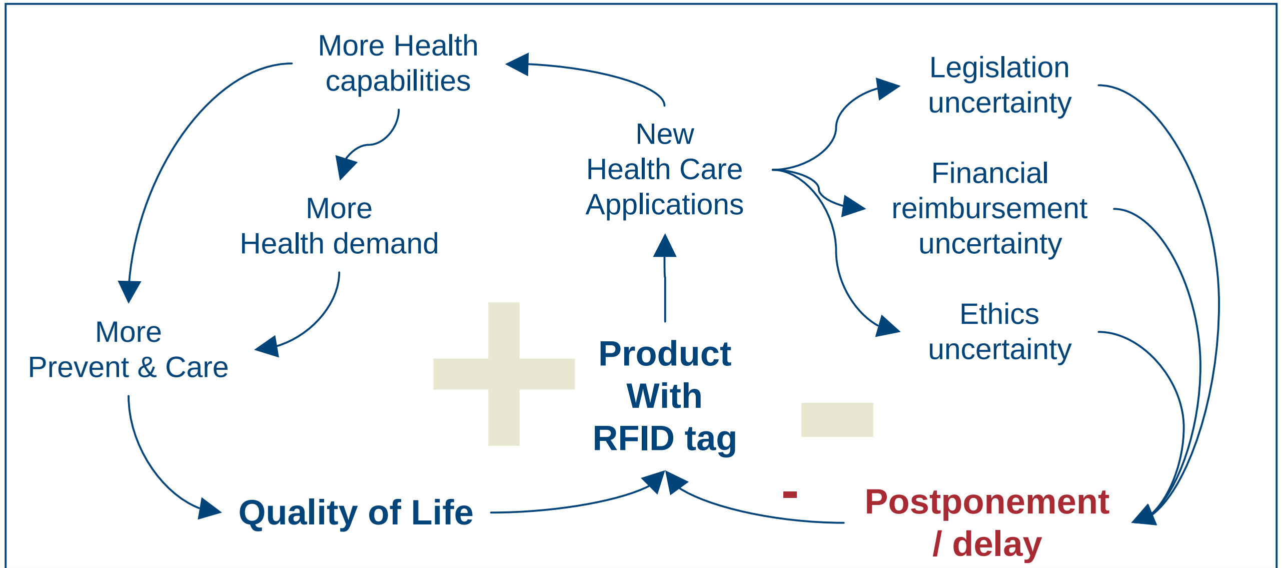
Resistance - examples





Quality, safety, fear, uncertainty, trust, etc are all qualitative aspects that influence the introduction/ growth of RFID applications. They are “overcome” by setting a good example or to show that it works without invoking all the negative.

The trade-off between quantitative and qualitative aspects is more complicated, especially if the “gain” is not modeled in the financial & insurance structures.

- what is the “price” of prevention?
- what is the “price” of an accidental death?

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Supporting remarks to the diagram: Resistance

- **Each partner in the Hospital Supply Chain needs to be able to “claim” a positive effect for it’s part of the chain.**
- **This effect must be durable: i.e also beyond the Pilot period.**
- **Partners need to look beyond their company boundaries to capitalise on the RFID potential.**
- **Technology standardisation may “hold back” partners for mass introduction, but a focus on a live business application will create they first breach in the Catch 22 situation:**
  - A hospital has multiple suppliers, but wants preferably one technology.
  - A supplier has multiple customers, but want to reduce the technology investment.
- **The benefit should be “marketed” such that resistance is taken into account.**
  - RFID has the potential of “replacing” manual activities that are covered by medical protocols. This will change the way how people work and it will change the role of the involved people.
  - RFID may tap into “big brother” fears. For starters, choose a less intrusive domain, make it a success, and use that as a basis for more.

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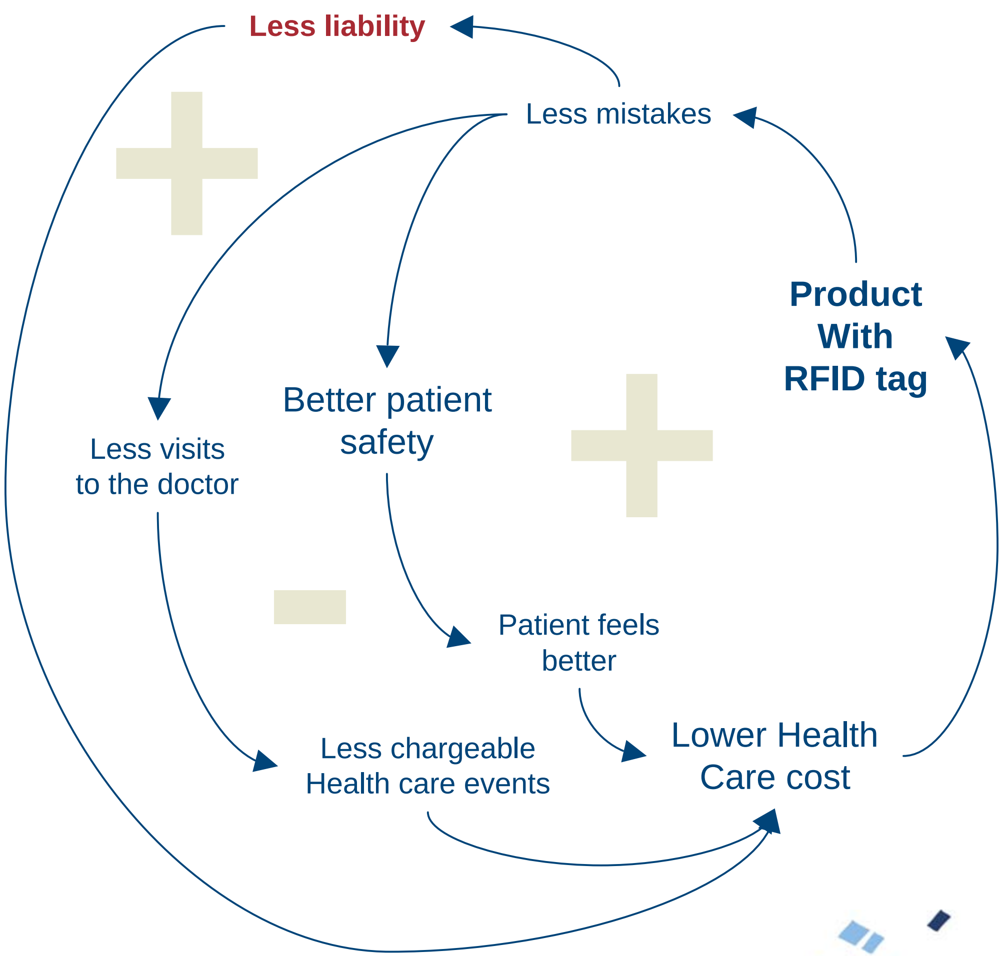
Additional remarks on liability cost/ benefits

– **Less medical mistakes are good for "society". It results in a patient feeling better, requires less return visits and we believe it will reduces health care cost.**

– **The study unveils the negative of less doctor visits: less income for the doctor/ specialist.**

– **As the first "saving" does not have a clear "owner" while the second one certainly does, it will require an additional straight forward, clear ownership element to support the usage of RFID:**
the benefit/ cost of liability

– **The more liability is incorporated in the decision making process, the more likely new techniques like RFID will be embraced.**



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The supply chain design is derived from the chosen applications. The design will drive the required technology.

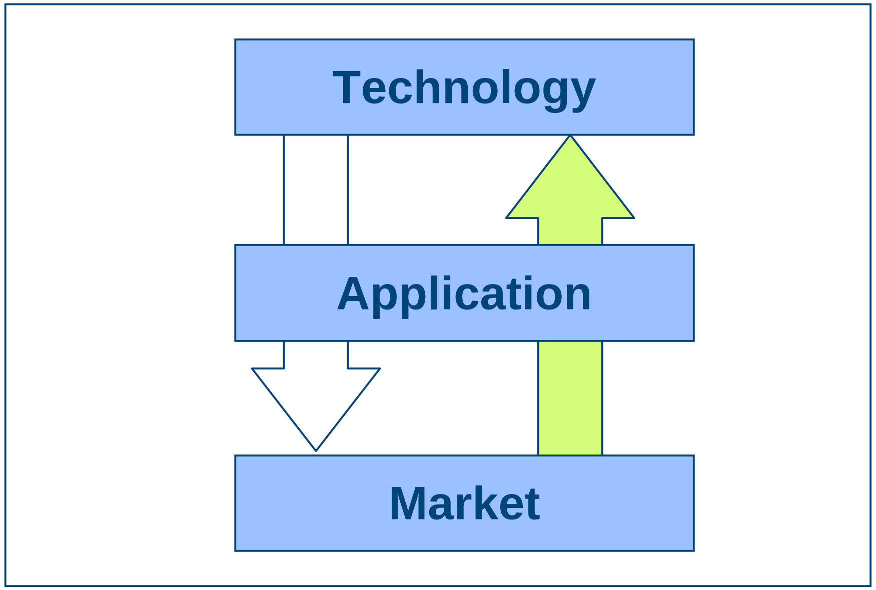
- **In this feasibility study the potential of RFID is not driven by the technology capabilities but by the market pull.**

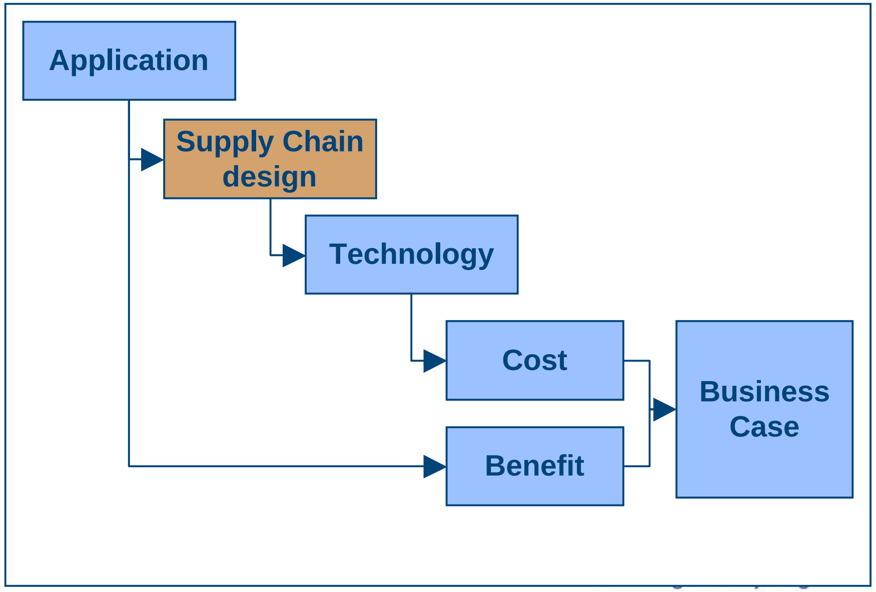
- **The question is not: "what can you do with RFID", but "what applications may benefit from the use of RFID"**

- **The applications identified are:**
  - Track & Trace from supplier to storage locations in the hospital (including reverse flows)
  - Inventory Management and VMI
  - Individualisation & patient safety

- **Introducing RFID in above applications will increase the initial cost due to new technology introduction.**

- **The potential unlocked in phase 2 must now be "translated" into benefits for each application**





The RFID business applications explained.

- **Track & Trace from supplier to storage locations in the hospital (including reverse flows)**
  - To be able to follow the product throughout the entire supply chain.
  - Use RFID to make the process more efficient.
  - Use RFID to capture data about the supply chain
    - Physiological data
    - Who handles the part
    - Etc.

- **Inventory Management and VMI**
  - Use the data collected from track & trace events in the inventory planning process
  - Use the data collected as a basis for Vendor Managed Inventory.

- **Individualisation & patient safety**
  - Create a connection between product, patient and doctor.
  - Create material flows for individual patients
  - Make sure no medical devices remain “in the patient” by accident

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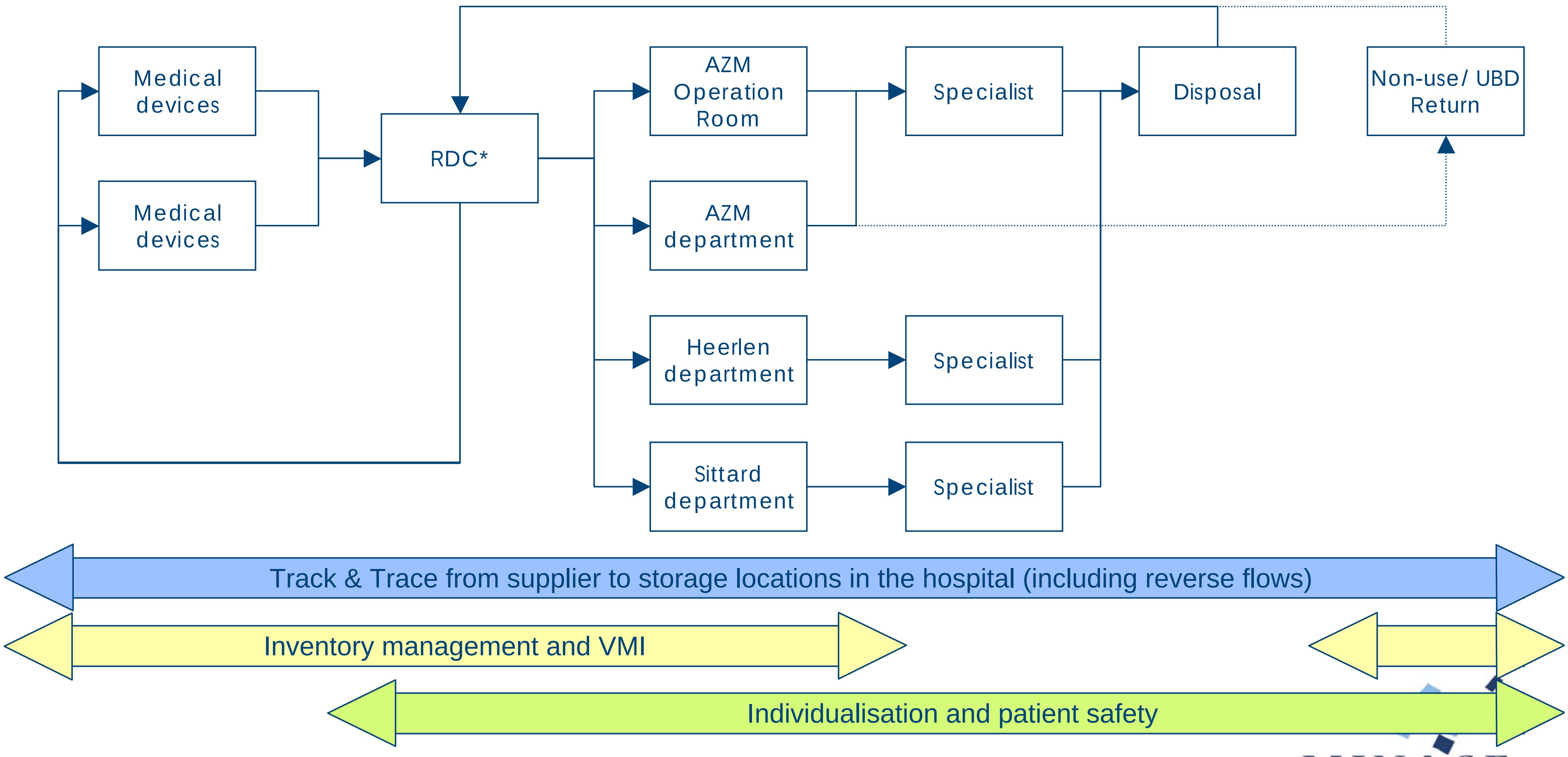
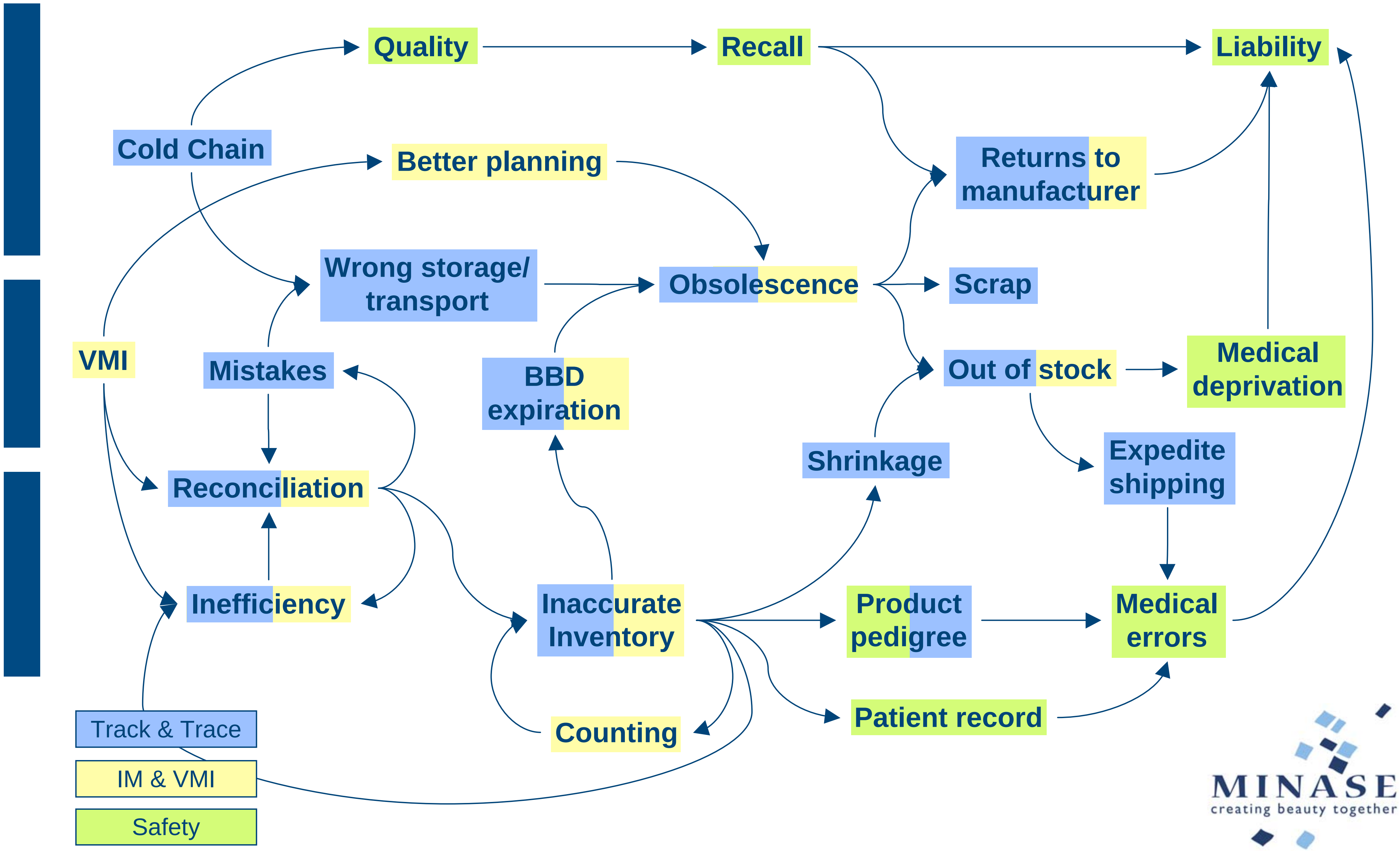
Based on the mentioned applications, the following is the supply chain design from medical devices



*) Regional Distribution Centre: the preempted merger of the logistics departments of the hospitals of Maastricht, Heerlen and Sittard.

Business drivers and issues are intrinsically linked to the chosen RFID applications and form an interrelated myriad of cause and effect.



The HF technology is the most suited for the chosen applications and is taking hospital radiation regulations* into account.

Band **Frequency ****	**LF** 125-135 KHz	**HF** 13.56 MHz		**UHF** 860-960 Mhz	**Microwave** 2.45 GHz
Type	smart tag	smart card (proximity)	smart tag (vincinity)	smart tag	smart tag
ISO	11784, 11785, 14223, 18000-2	14443, 18092, 21481	15693, 18000-3	18000-6	18000-4
EPC compliant	No	Class 1	Class 1	Class 0, 1	n/a
Read distance	< 1.5 mtr	< 10 cm	< 1.5 mtr	Gen 1: < 4 mtr Gen 2: < 7 mtr	Passive: 1-20 mtr Active: > 100 mtr
Price	€1 - €80	€0,20 - €0,45		€0,05 - €0,50	€20 - €70
Encryption	Average	Heave	Possible	Possible	Not yet
Read obstacles	Metal: ☺ Water: ☺	Metal: 😐 Water: ☺	Metal: 😐 Water: ☺	Metal: ☺ Water: 😐	Metal: 😐 Water: ☹
Application	– Access control –Electronic keys –Identification cattle/ animals	–Passport –Badges –(bank) Card –OV card –Loyalty card –Patient card	–Article, pallet & container tracking –Supply Chain management and control –Property security –Product authenticity & safety –Product pedigree –Supermarket check-out		–Container and vehicle tracking

(*) TNO: Most technology development is on UHF, while HF is the only hospital safe RFID technology.
(**) In the technology pipeline - two new frequencies: 5.8 GHz (18000-5) en 433 MHz (18000-7)

Source: EPCGlobal, ISO, NEDAP & Philips Semi Conductors, TNO

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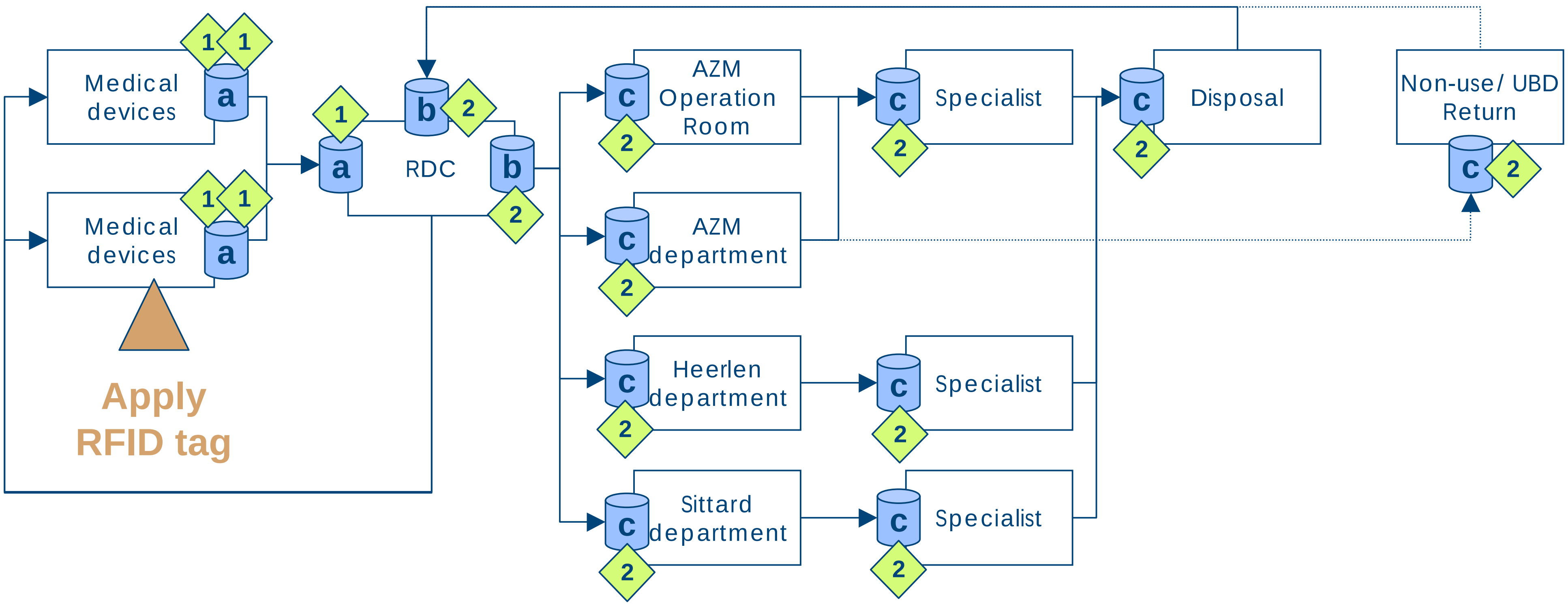
RFID technology will be introduced on the following locations in the supply chain



= RFID read/ write equipment (a = large, b = medium, c = small)

= interface (1 = large, 2 = small)

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Introduction of RFID technology will incur the following cost elements

Supplier

Hospital

Implementation/ cost element	Tag	Equipment			Interface		Cost
		a	b	c	1	2	
RFID tag	11000						3kEur
Application of tag to package	11000						2kEur
Read/ write equipment at supplier site		2x					40kEur
Interface to supplier IT system					2x		20kEur
Read/ write equipment at hospital RDC/ DC site							
–Inbound		1x					20kEur
–Outbound			1x				10kEur
RDC interface to hospital IT system					2x		20kEur
Read/ write equipment at hospital department loc.				10x			10kEur
Department interface to hospital IT system						1x	5kEur
Read/ write equipment for specialist/ end-user				10x			10kEur
End-user interface to hospital IT system						1x	5kEur
Read/ write equipment for reverse flows at RDC			1x				10kEur
Reverse flow interface to hospital IT system					1x		10kEur
Sum of Cost							165kEur

Justification of incurred cost elements

Technology

– For the specified applications the HF RFID technology is selected. The cost of 25 cents per tag is price mid-point. Very rapidly this will drop to the 10 cent zone.

RFID Read/ write equipment:

a) large: port for bulk reading (pallet) @ 20 kEur
b) medium: port for bulk reading (box) @ 10 kEur
c) small: stand alone/ portable device @ 1 kEur

Interface from read/ write equipment to local IT system:

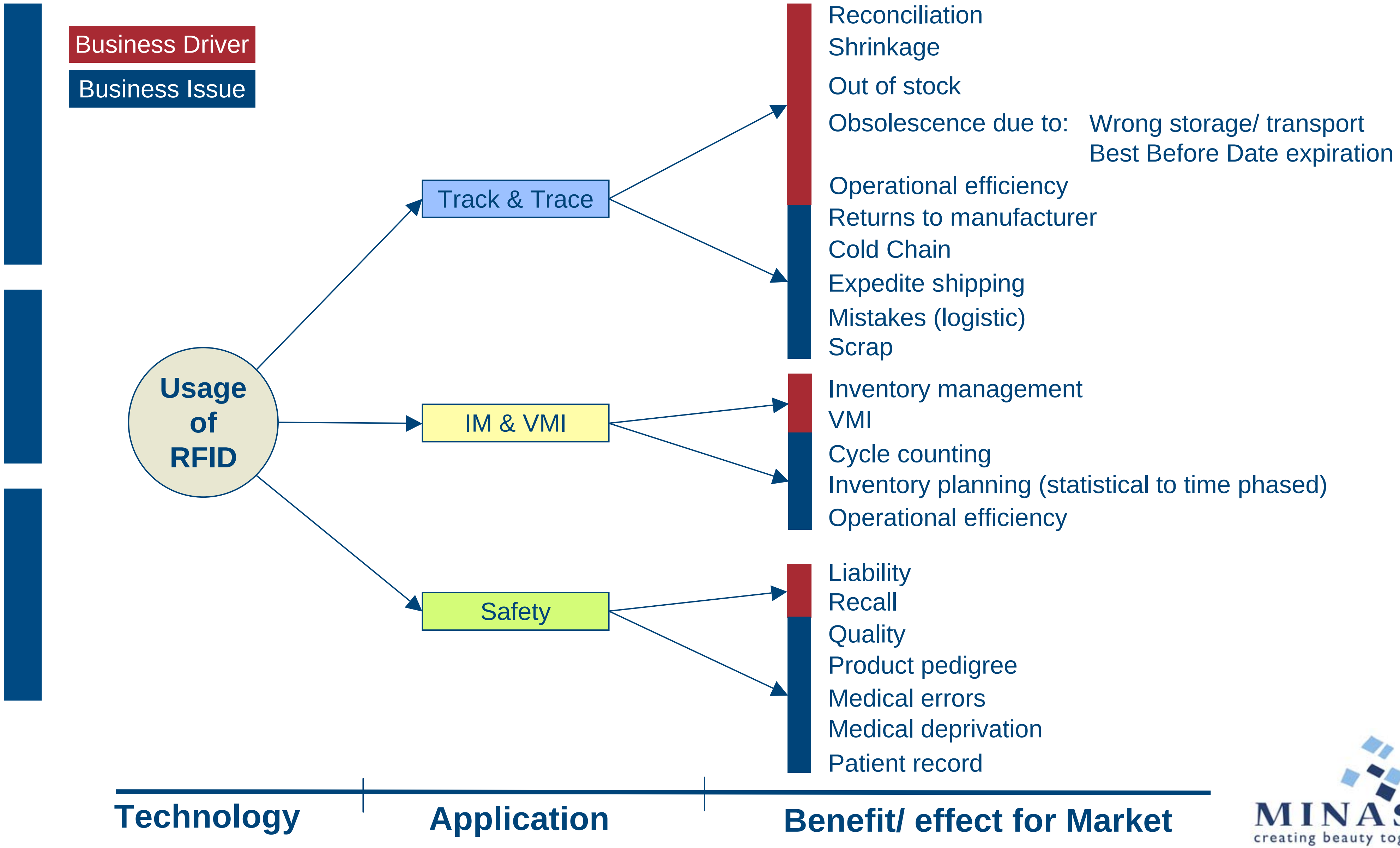
1) Large: high(er) volume, multiple tags per event @ 10 kEur
2) Small: low volume single tag per event @ 5 kEur

RFID volume

– Quantities based on single supplier (J&J) volume to single hospital (AZM) per annum extrapolated for RDC concept (3 merging hospitals) @ 11000 pcs/ year

All prices as per January 2007
Source: EPC Global, RFID Journal and ECCT

The application areas identified can be mapped on different drivers and issues identified in industries*.



*) Source: EPC Global, RFID Journal and team analysis

The calculated benefits are based on operational figures supplied by AZM and RFID savings taken from the “RFID/EPC calculator”.

The reduction percentages are derived from the EPC Global “RFID/EPC calculator”. Both the retail CPG and pharmaceutical models have been used.

The baseline cost and inventory figures have been provided by AZM and are based on the Johnson & Johnson product set. All figures have been extrapolated to capture the RDC concept with Heerlen and Sittard hospital.

SKU:	232 products	
Inventory:	525 kEur	
Demand:	11000 pieces per annum	
	2748 kEur per annum	
Handling cost:	110 kEur (15 minutes per part @ 40 Eur/hour)	operational cost
IM cost:	52,5 kEur (10% of inventory value)	operational cost
Dead* inventory:	157,5 kEur (30% of inventory value)	inventory value
Operational FTE:	50 kEur (1 person for 11000 disbursements)	operational cost
Expediting cost:	27,5 kEur (5% of 11000 @ 50 Eur per incident)	operational cost
Return cost:	82,5 kEur (30% returns of 11000 @ 25 Eur per incident)	operational cost
Recall cost:	120 kEur (5% of 232 @ 10kEur per incident)	operational cost
Cycle count cost:	4 kEur (4 counts per annum at 1000 Eur/ count)	operational cost
Patient record:	73 kEur (10 minutes per record update @ 40 Eur/hour)	operational cost

Source: EPC Global and AZM

*) Dead inventory is non-usable inventory. Causes: shrinkage, non usability due to obsolescence, inventory planned but not really required.

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Benefits - Track & Trace from supplier to storage locations in the hospital (including reverse flows)

Track & Trace

	Benefit	Description	Effect on	Reduct.	Value (kEur)	
					Inv.	Cost
Driver	Reconciliation	Due to the fact that many parties are involved in the exchange of medical products, differences and mistakes will require reconciliation.	Handling cost	-15%		16,5
	Shrinkage	The effect of products being “lost” due to record inaccuracies, theft and misusage.	Dead inventory	-20%	31,5	
	Out of Stock	The situation that no products are available for use. Out of stock has many causes and has significant impacts.	Expediting cost	indirect		
	Obsolescence	The fact of having products in stock which are not usable anymore. Either because something is wrong with the product or because one had an incorrect planning.	Returns & Scrap	-15%		12,4
	Operational efficiency	Looking at ways to reduce redundant operations, reduction of labour cost and reduction of manual operations.	T&T Manual labour	-90%		45,0
Issue	Returns	The effect of returning products to the manufacturer caused by obsolescence or recalls.	Handling cost	-10%		11,0
	Cold Chain	Certain medical products require special storage conditions, e.g. Cold chain for vaccines. Non compliance will lead to obsolescence.	Obsolescence	indirect		
	Expedite shipping	As a result of not having the required products, emergency shipments will be required, incurring a lot of cost and disturbances to the regular way of working.	Expediting cost	-60%		16,5
	Mistakes	Mistakes occur as a result of (too) complex process definitions and confusing application of technology (malice excluded)	Reconciliation & efficiency	indirect		
	Scrap	If obsolete products can not be returned to and salvaged from the manufacturer, scrap is the last and most costly option.	Dead inventory	-30%	47,3	

Benefits - Inventory Management and VMI

IM & VMI

	Benefit	Description	Effect on	Reduct.	Value (kEur)	
					Inv.	Cost
Driver	Inventory accuracy Inventory management	The process of inventory management has as goal to ensure an optimal inventory by maintaining an as accurate as possible record of the actual situation. The more accurate, the less negative effects will occur in the supply chain.	Shrinkage Pedigree Counting Obsolescence Oper efficiency	indirect		
Driver	VMI	The vendor will takes responsibility of the inventory ownership and management issues, while the hospital has the products physically available on premises.	Inventory cost & planning cost	-100% *	399	
Issue	Cycle counting	The process of physically checking the inventory and matching it with the record in the Inventory management systems.	Labour cost	-75% **		3
Issue	Inventory planning	Having the most accurate and time supply and demand data will enable a more efficient inventory planning.	Dead inventory	-30%	47,3	15,8
Issue	Operation efficiency	Looking at ways to reduce redundant operations, reduction of labour cost and reduction of manual operations.	IM operational cost	-15%		7,9

*) The reduction of 100% is from a hospital perspective. The 100% is after optimising for Shrinkage, Scrap and Inventory planning savings. From the integral supply chain view point, VMI is "moving" the inventory from hospital to supplier. Only when the supplier can do a better planning job and obtain economies of scale savings, the integral supply chain inventory will drop.

**) From 4 counts per year to 1.

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Benefits - Individualisation & patient safety

Safety

	Benefit	Description	Effect on	Reduct.	Value (kEur) Inv.	Value (kEur) Cost
Driver	Liability	If anything goes wrong when using a medical product on a patient for whatever reason this will cause harm and/ or require “repair” actions. Socially this is not acceptable ... but translation into cost is the driver to justify new technology applications.	Cost Image Treatment cost	-x% -5%		* **
Driver	Recall	When a (batch of a) product is withdrawn from the market due to danger or patient health, a recall is initiated. All products (belonging to certain batches) have to be identified and return. Products used/ applied must be traced and reported.	Recall cost	-25%		30
Issue	Product quality	It is always possible something is wrong with a (batch of a) product. When detected in time it will lead to a recall, if too late then it will cause medical errors.	Recall Medical errors	indirect		
Issue	Product pedigree	Pharmaceutical / medical products are subject to strict pedigree regulations: at all times all products must be accounted for.	Medical errors	indirect		
Issue	Medical errors	Medical errors are caused by acting on wrong information (malice excluded) or when something is wrong with the product quality.	Liability Image	indirect		
Issue	Medical deprivation	Non-availability of products causes medical deprivation. A surgery/ treatment will have to be postponed and rescheduled. Logistics will have to expedite product shipments.	Treatment cost	-5%		**
Issue	Patient record	All medical actions end up in a patient record. This is a tedious task and a lot of administration. Better/ faster product/ patient recognition may result in treatment individualisation.	Labour cost	-75%		54,8

*) Reduction of Liability cost due to usage of RFID could not be quantified due to lack of historical data.
**) Based on interviews there is and intuitive agreement on the reduction of treatment cost. Baseline treatment cost are not measured by involved cluster partners.

It requires multiple RFID applications to create a positive business case.

Tag	5
Equipment	100
IT Interfaces	60

Cost
165 kEur

	Inv* saving	Cost saving
Track & Trace	79	101
IM & VMI	446	27
Safety	-	>85

Benefit
213 kEur

*) Inventory savings are a direct reduction of assets. Depending on accounting practices these savings will translate into cost savings. E.g. Interest cost. In the balance of the scale the inventory savings are left out of the equation.

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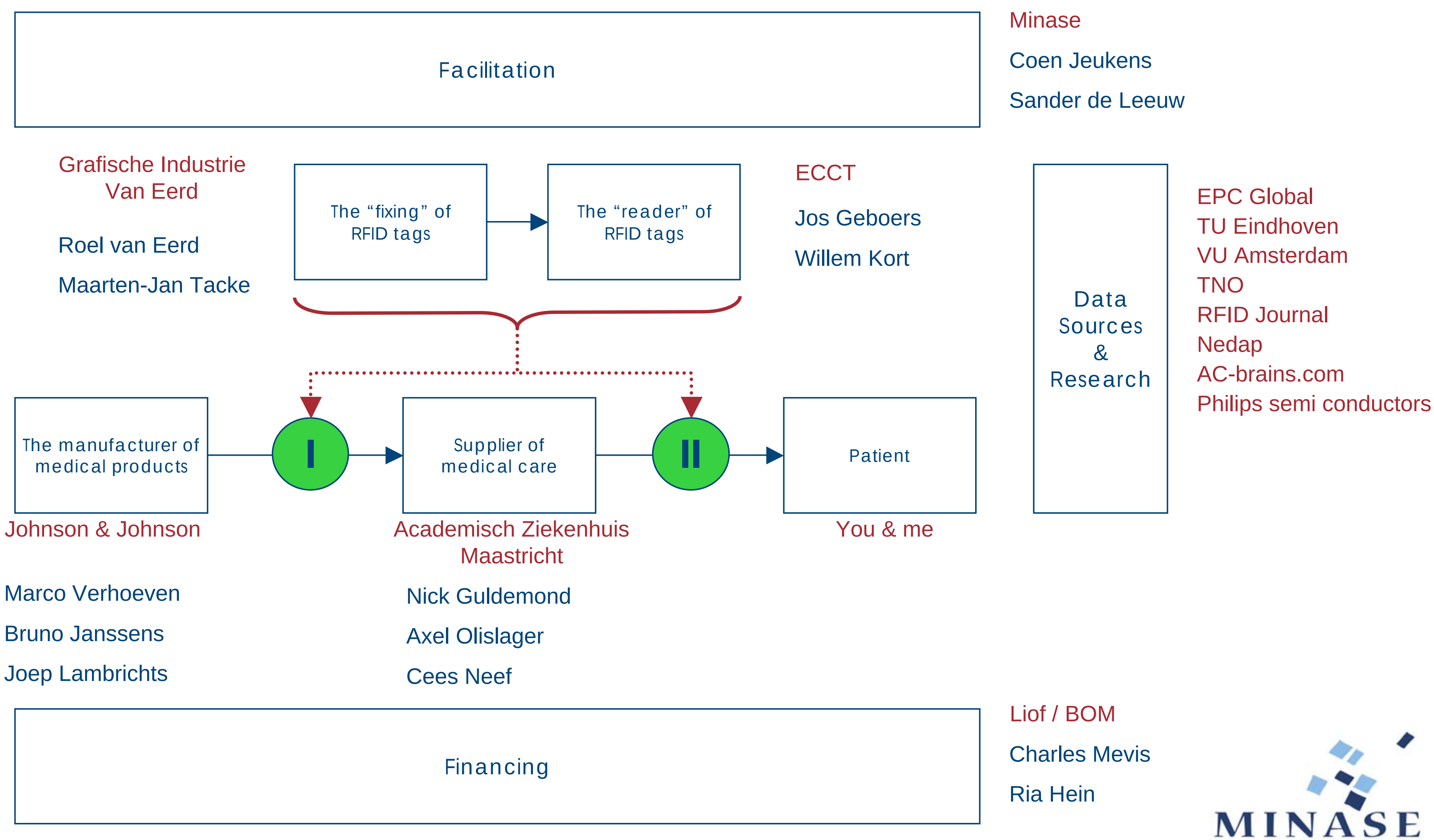

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This RFID feasibility study is executed by:

Ir. Th.C.G. Jeukens	**06-4640 8444**
Dr. Ir. S.L.J.M. De Leeuw	**06-5430 5652**

On behalf of:

Minase consultancy	**www.minase.nl**

For cluster partners:

Academisch Ziekenhuis Maastricht	**www.azm.nl**
ECCT	**www.ecct.com**
Van Eerd	**www.vaneerd.nl**
Johnson & Johnson / Cordis	**www.cordis.com**

Financed by:

I-zone	**www.innovationzone.nl**

Email: info@minase.nl

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