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THE INFLUENCE OF THE BUILT ENVIRONMENT ON PATIENT SAFETY AND WELL-BEING: A FUNCTIONAL PERSPECTIVE

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BACKGROUND

- **Built environment (BE) requirements** have been defined as **building attributes** - components, utilities, and spaces - that should be in place so that the BE fulfill the **needs of end users** – patients, visitors, workers

  - **High abstraction** level: **patient safety and well-being** (Lucas et al., 2012);
  - **Evidence Based Design (EBD):** decision-making supported on evidence available in the literature (Ulrich et al., 2008; Rybkowski, 2009)
    - Some **BE conditions** | **noise, light, privacy, comfort, access to the external environment, and accessibility** (Ulrich et al., 2008; Rybkowski, 2009; Hicks et al., 2015)

- **BE design decisions** that benefit patient safety and well-being.
  - **value generation |** customer viewpoint – **patient** - and **flow** of activities - **healthcare services** (Koskela, 2000).

BACKGROUND

- The analysis of how a system functions should emphasize **work-as-done (WAD)** (Hollnagel, 2012): ⟶ **EBD**
  - However, **BE design** –**WAI | conflict** with the dynamic nature of **healthcare** (Hollnagel et al., 2014): **WAD x WAI**

- The **Functional Resonance Analysis Method (FRAM) -** Hollnagel (2012):
- Understanding **variability propagation** and accounting for the **complexity of projects**
  - **Modelling interactions** between **BE** and **patient safety and well-being** in an adult Intensive Care Unit (**ICU**);

BACKGROUND

- Part of a **broader research** project carried out at the same ICU, in which a **framework for the integrated modelling of BE** and other functional requirements was applied (**Ransolin et al., 2020**).
  - Combined use of **FRAM** and Building Information Modelling (**BIM**) for **requirements management**.

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Integrated modelling of built environment and functional requirements: Implications for resilience

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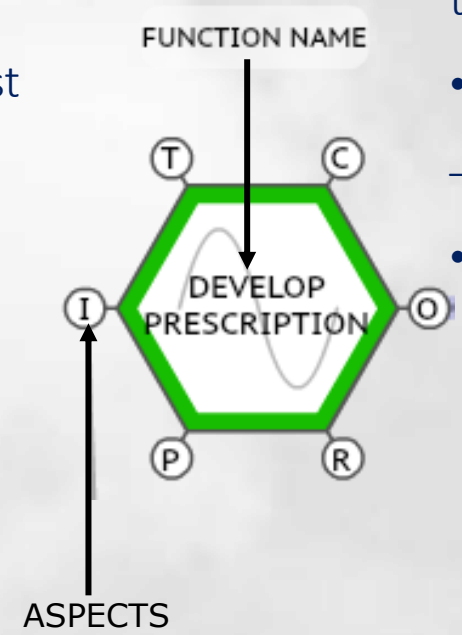
PRINCIPLES OF FRAM

- A **FRAM** model consists of **interconnected functions**, their corresponding **variabilities**, and **couplings** between functions. Description of the functions according to **six aspects** (Hollnagel, 2012):
  - **Input (I) |** what **starts** the function / **processes** ;
  - **Output (O) | result** - entity or a state change;
  - **Preconditions (P) |** conditions that must be exist **before** a function can be carried out – **BE requirements (Ransolin et al., 2020)**;



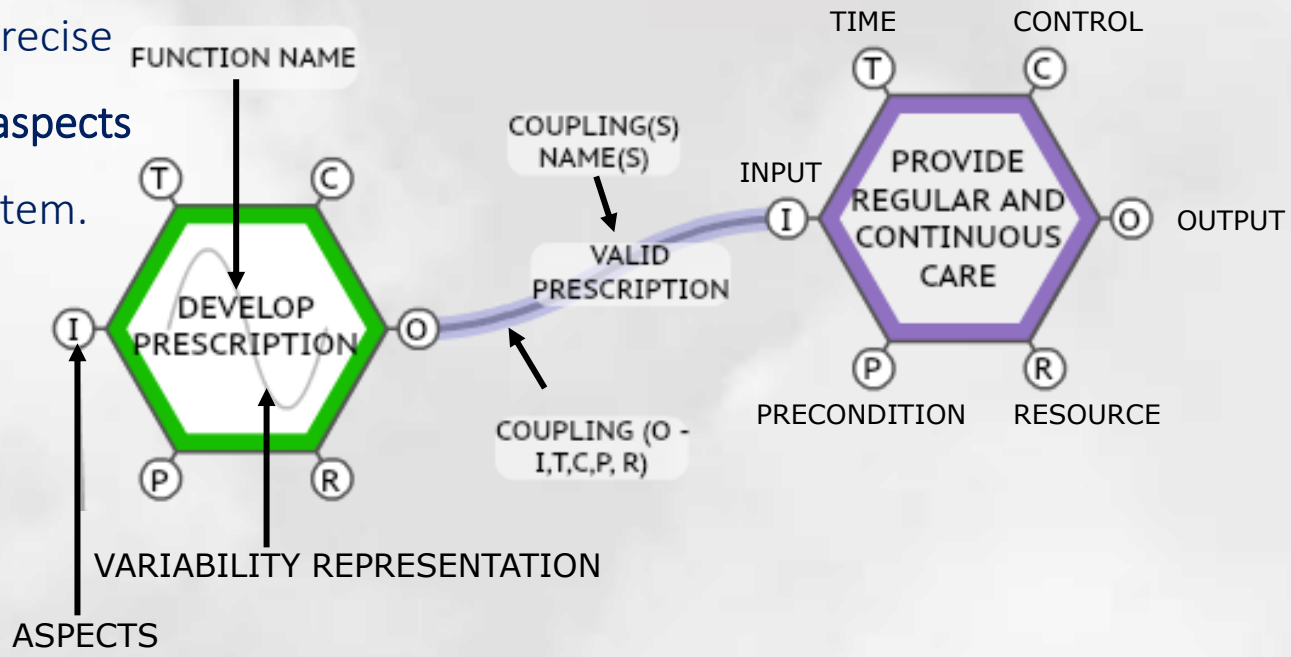
  - **Resources (R) |** what a function **consumes** to produce the output;
  - **Time (T) | temporal constraints** – starting/finishing time or duration;
  - **Control (C) |** how the function is **monitored or controlled**.

PRINCIPLES OF FRAM

- A **FRAM** model consists of **interconnected functions**, their corresponding **variabilities**, and **couplings** between functions. Description of the functions according to **six aspects** (Hollnagel, 2012):

- **Variability** |**Time** too early, on-time, too late, or not at all
  Precision imprecise, acceptable, or precise
- **Couplings** | outputs are **connected to the other aspects variability propagation** across the system.

Functional resonance | manifestation of the **unintended interaction** of the normal variability of each function.



ASSUMPTIONS

- A **FRAM** model consists of **interconnected functions**, their corresponding **variabilities**, and **couplings** between functions. Description of the functions according to **six aspects** (Hollnagel, 2012):
    - **Variability** by **unfulfilled BE requirements.** It propagates across the system through **functions** -caregivers and patients;
    - **BE impact** on patient safety and well-being are **moderated by the functions** carried in the workspace;

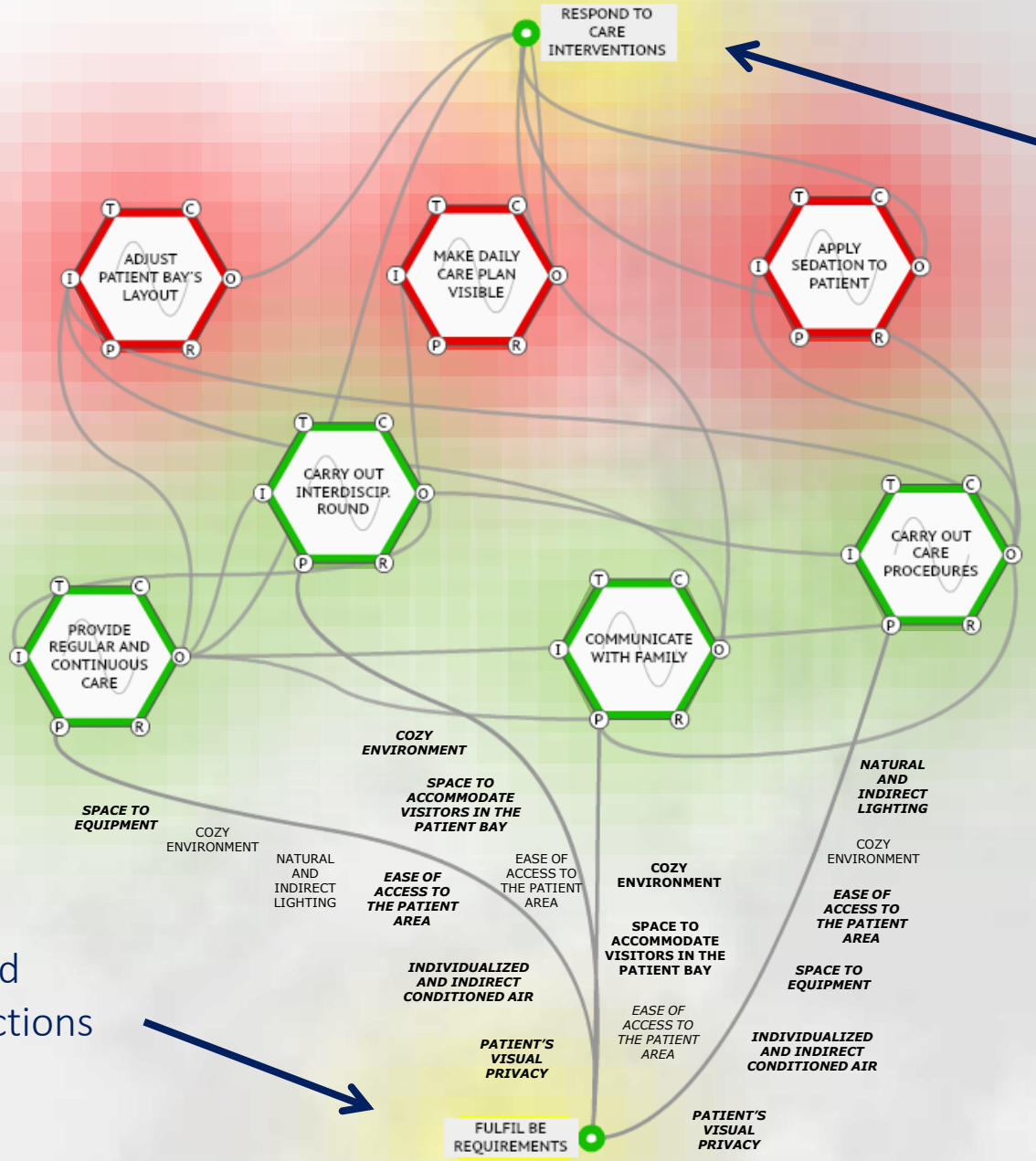
Functional resonance | manifestation of the **unintended interaction** of the normal variability of each function.

RESULTS

Resilience performance functions

Functions defining the model **boundaries**

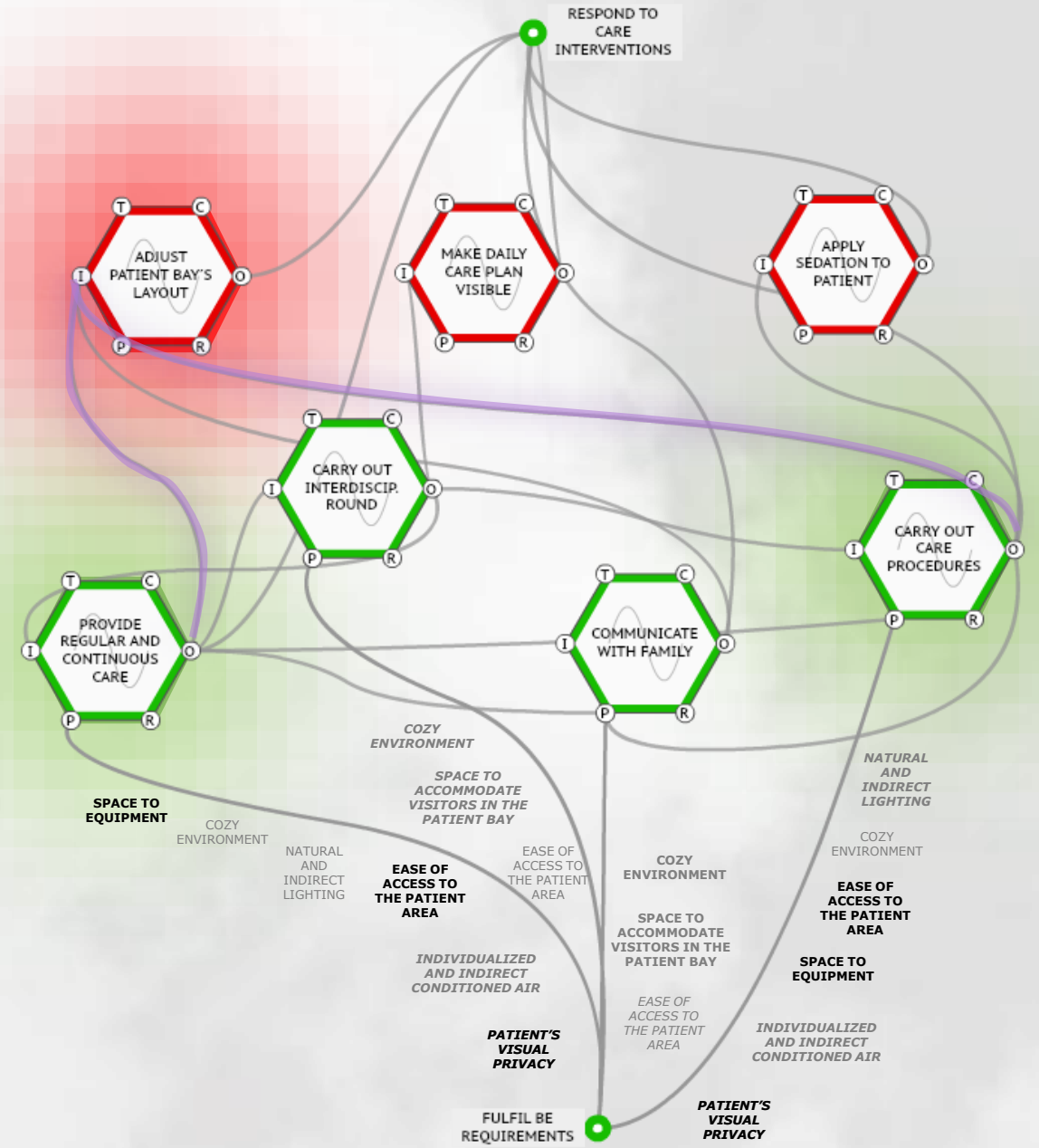
Provide **preconditions** and other aspects to the functions carried out by caregivers



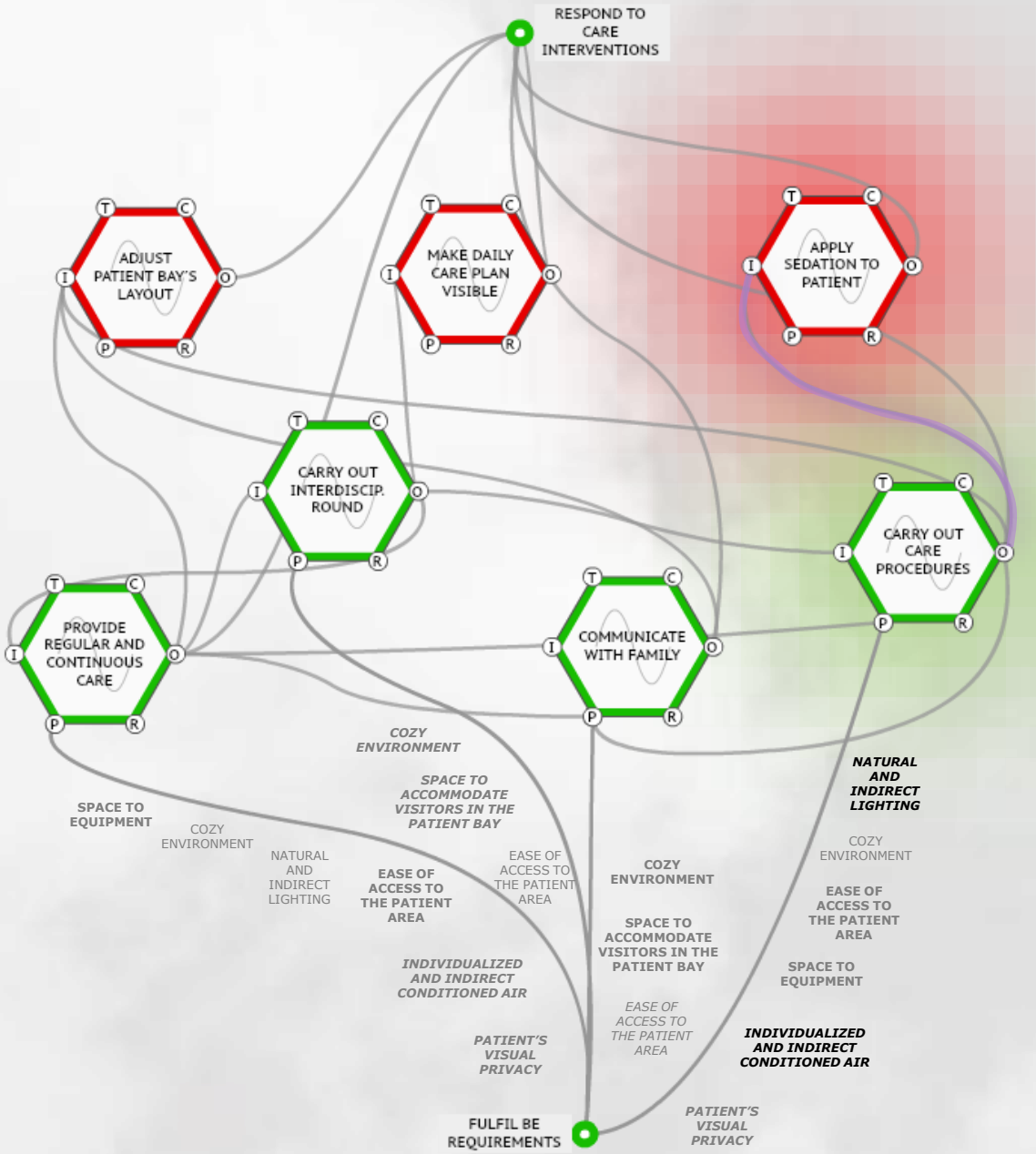
Performed by **patients**

Care functions

RESULTS


RESPOND TO CARE INTERVENTIONS
ADJUST PATIENT BAY'S LAYOUT
MAKE DAILY CARE PLAN VISIBLE
APPLY SEDATION TO PATIENT
CARRY OUT INTERDISCIP. ROUND
CARRY OUT CARE PROCEDURES
PROVIDE REGULAR AND CONTINUOUS CARE
COMMUNICATE WITH FAMILY
FULFIL BE REQUIREMENTS
COZY ENVIRONMENT
SPACE TO ACCOMMODATE VISITORS IN THE PATIENT BAY
NATURAL AND INDIRECT LIGHTING
SPACE TO EQUIPMENT
EASE OF ACCESS TO THE PATIENT AREA
INDIVIDUALIZED AND INDIRECT CONDITIONED AIR
PATIENT'S VISUAL PRIVACY

RESULTS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DISCUSSION AND CONCLUSIONS

- **Variability in fulfilling BE requirements propagates across space and time through everyday functions of caregivers, hindering patient safety and well-being.**
  - Understanding **how employees cope** with unfulfilled BE requirements: displaying **resilient performance**;
- **Resilience** may imply in the creation of **new functions**, hence increasing opportunities for **unwanted interactions**;

- **Traditional BE design management** practices usually **disregard WAD** and its variability.
- Strengthen the **EBD** literature by acknowledging that **variability** is to some extent unavoidable in healthcare;
- **Value generation** |supporting the **fulfillment of BE requirements** that impact **patient safety and well-being**.

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THANK YOU !

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