A Few Words First

Courtesy – Please mute your phone (*6 toggle)

Roll call

Full day tutorial October 23 – *Applying MBSE to Interface Design & Management* – Mathew Hause.

Sep 9 Meeting – Agile 104: Quality Fundamentals, the Art of SE (Rick Dove)
This will be a preview of the INCOSE Webinar Sep 16.

Sep 25-27: Open Colorado Chapter workshop: The Application of Transformational Thinking to the Global Energy Water Nexus.
Bargain price $75-$100 for this three day workshop, see recent email.

Revised Chapter Bylaws were accepted by membership vote (closed July 31).

Considering INCOSE SEP accreditation?
details: www.certificationtraining-int.com/csep-preparation-course/

CSEP Preparation 4-Day Course will place you in the best possible position to pass the CSEP exam. To learn how to successfully pass the exam and complete the application, join a course near you:

2015 Course Schedule (close by, others available as well):
Aug 17 - 20 | Austin, TX
Nov 02 - 05 | Las Vegas, NV

Enchantment Chapter Monthly Meeting

12 Aug, 2015 – 4:45-6:00 pm:

Agile System Modeling and Lifecycle Engineering with Object-Process Methodology – OPM the New ISO/PAS 19450 standard

Dov Dori, PhD, Technion Israel Institute of Technology, head of the Enterprise System Modeling Laboratory. Currently visiting professor at MIT.
dori@mit.edu

Abstract: Model-based systems engineering promotes the use of modeling and models as focal design artifacts to enhance the rigor and robustness of systems engineering activities throughout the various phases of a system's life cycle, with emphasis on the early, conceptual phases. The Object Management Group's Systems Modeling Language (SysML) and Object-Process Methodology (OPM) are the two conceptual modeling languages currently in use. In this presentation, Technion Professor Dov Dori, currently a visiting faculty at MIT, will:

- **highlight the working principles of OPM, with examples from various domains;**
- **explain the differences between OPM and SysML; and**
- **present the upcoming ISO 19450 OPM standard.**

Download slides today-only from GlobalMeetFifteen file library or anytime from the Library at www.incose.org/enchantment

NOTE: This meeting will be recorded

Agile System Modeling and Lifecycle Engineering with Object-Process Methodology

Discussion Things to Think About

- What might be compelling reasons to try OPM, even if you are already using SysML?
- Does SysML satisfy your needs for communicating concept models to management?
- What needed capability does SysML provide that OPM doesn't satisfy?
- Is OPM more agile than SysML? Why might that matter?
- Have you got a simple-project test for OPM, to try it out?

Speaker Bio

Dov Dori is a visiting professor in MIT's Engineering Systems Division. He is the Harry Lebensfeld Chair in Industrial Engineering and head of the Enterprise System Modeling Laboratory at the Faculty of Industrial Engineering and Management, Technion, Israel Institute of Technology.

He holds a Ph.D. in computer science from Weizmann Institute of Science, an M.Sc. in operations research from Tel Aviv University, and a B.Sc. in industrial engineering and management from Technion.

His research interests include model-based systems engineering, conceptual modeling of complex systems, system architecture and design, software and systems engineering, and systems biology.

Dori invented and developed Object-Process Methodology (OPM), the emerging ISO 19450 standard. He is an INCOSE fellow and a fellow of the International Association for Pattern Recognition. He is also a member of the International Honor Society for Systems Engineering, Omega Alpha Association.

Agile System Modeling and Lifecycle Engineering with Object-Process Methodology – OPM the New ISO/PAS 19450 standard

Dov Dori
Massachusetts Institute of Technology
Technion, Israel Institute of Technology

INCOSE Enchantment (New Mexico)
Chapter Webinar
Aug. 12, 2015

What will this talk be about?

- Need for an agile overarching methodology for SE that encompasses entire systems' lifecycle
- Object-Process Methodology – OPM, the new ISO/PAS 19450 is ideal for this job
- Crash OPM course with real life specification of SRI International's Video Moving Target Indication Capability for OSRVT
- Highlights of OPM Agile MBSE and potential benefits

SRI International
SARNOFF

OSRVT: Video Moving Target Indication Capability

Presented to

SRI International

November 10, 2014

OSRVT: One System Remote Video Terminal System

Textron's One System Remote Video Terminal, a laptop soldiers on the ground can use to see a drone's video and control its sensors.

Objective

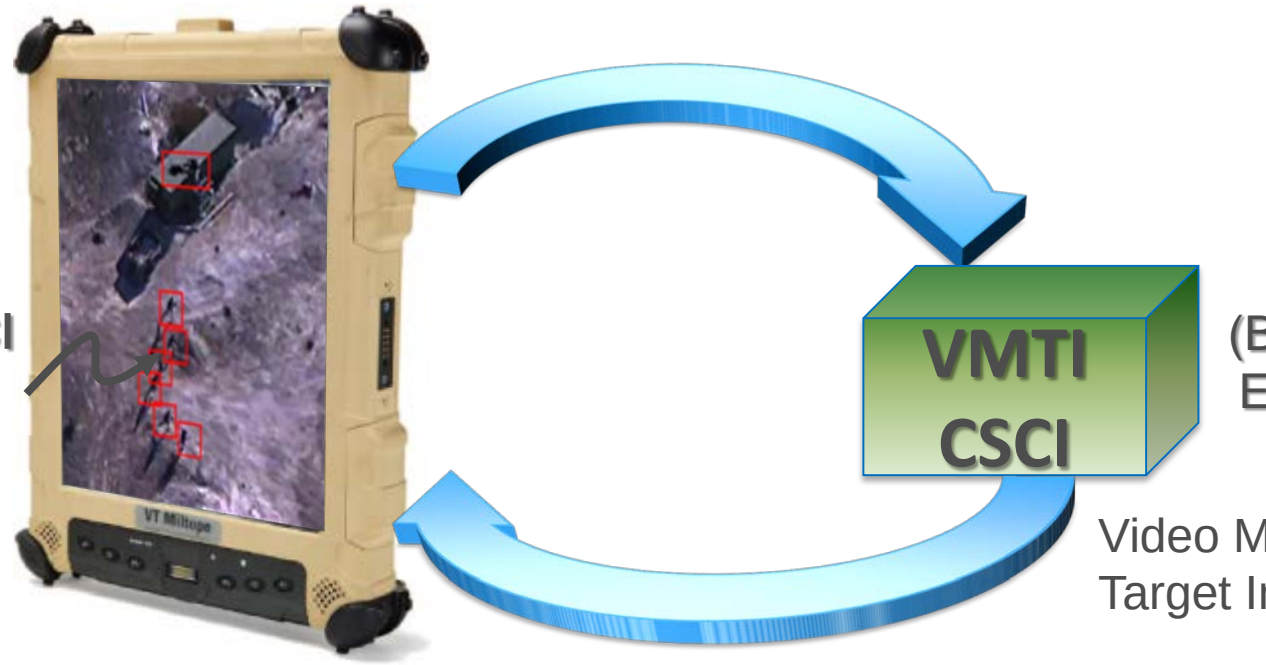
Adding Video Moving Target Indication* (VMTI) capability for OSRVT using platform data stream (e.g., MPEG2 TS)

*A computational process of locating a moving object (or several ones) in a video frame. No ID reported.

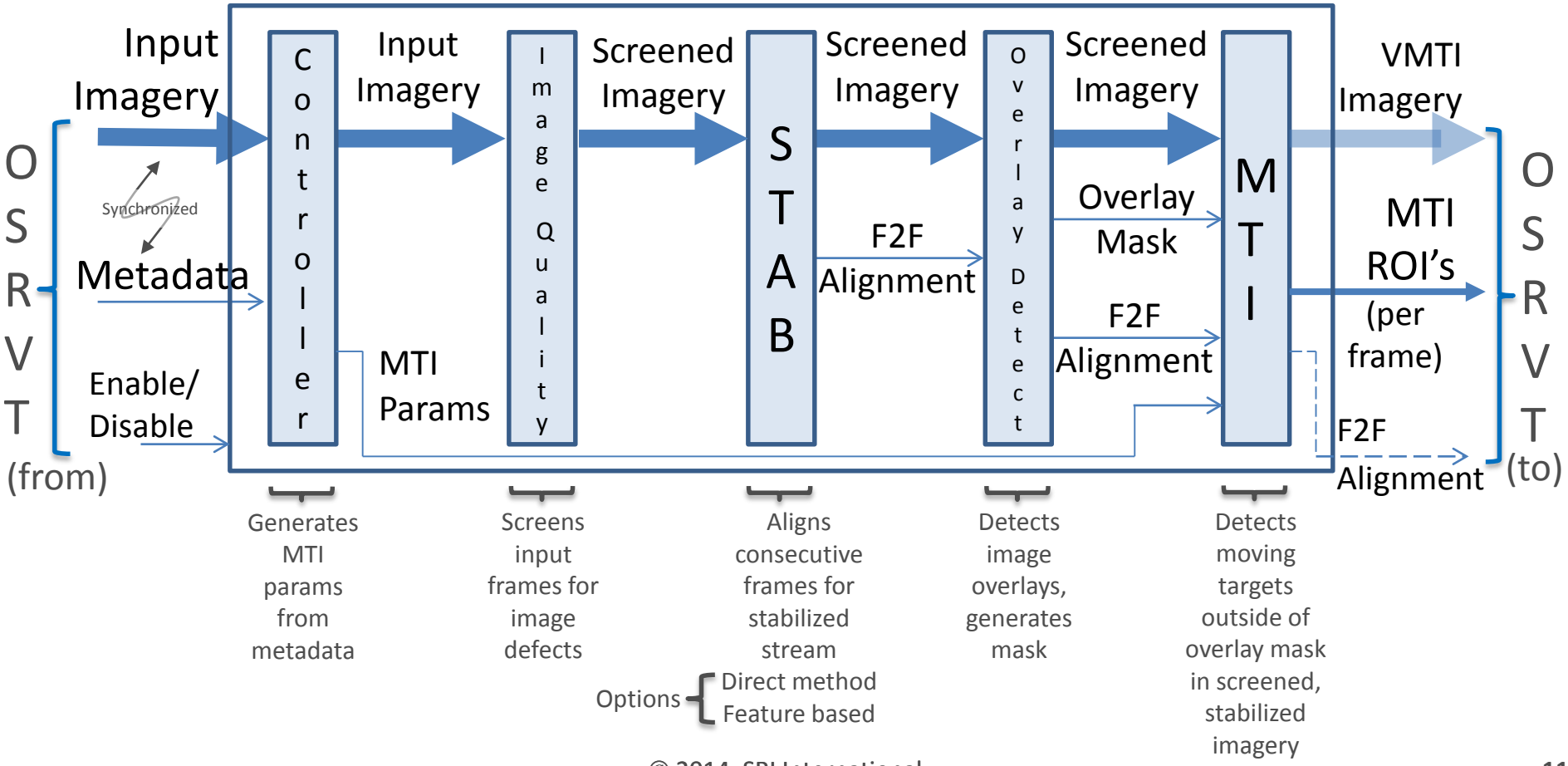
Note: Introduction of such a capability will have little or no impact on other OSRVT operations.

OSRVT VMTI System

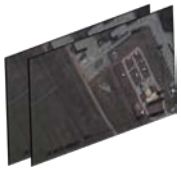
OSRVT: One System Remote Video Terminal System



VMTI Module

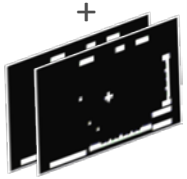


Moving Target Indication



Video frames (stabilized) with moving targets

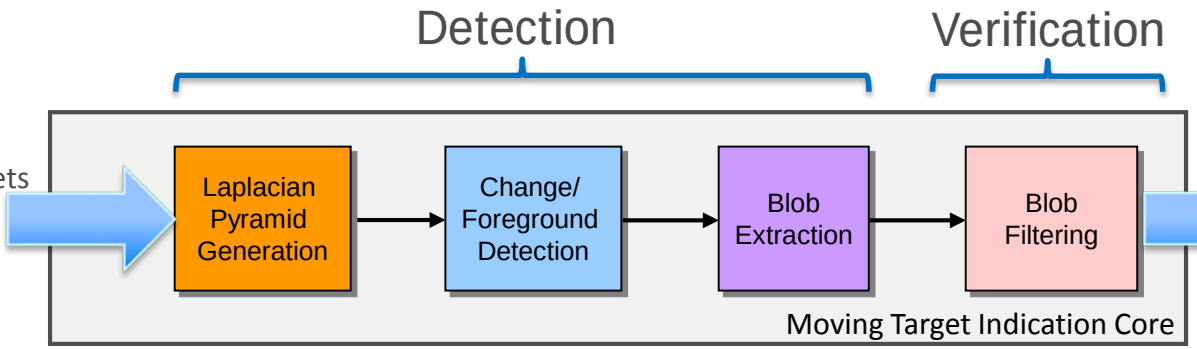
+



Overlay mask imagery

+

MTI parameters



Generates multi-resolution features (Laplacian)

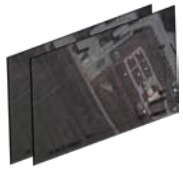
Detects pixel-based spatio-temporal changes, relative to stabilized "background," due to "foreground" features from a particular pyramid level (as specified by MTI parameters)

Extracts "blobs" or connected foreground "change" pixels

Filters "blobs" fulfilling motion consistency (temporal) check

Video frames (original) with moving target indications (VMTI imagery)

MTI Core Details



Video frames (stabilized) with moving targets

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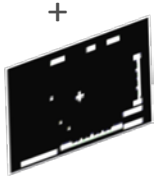

Overlay mask imagery

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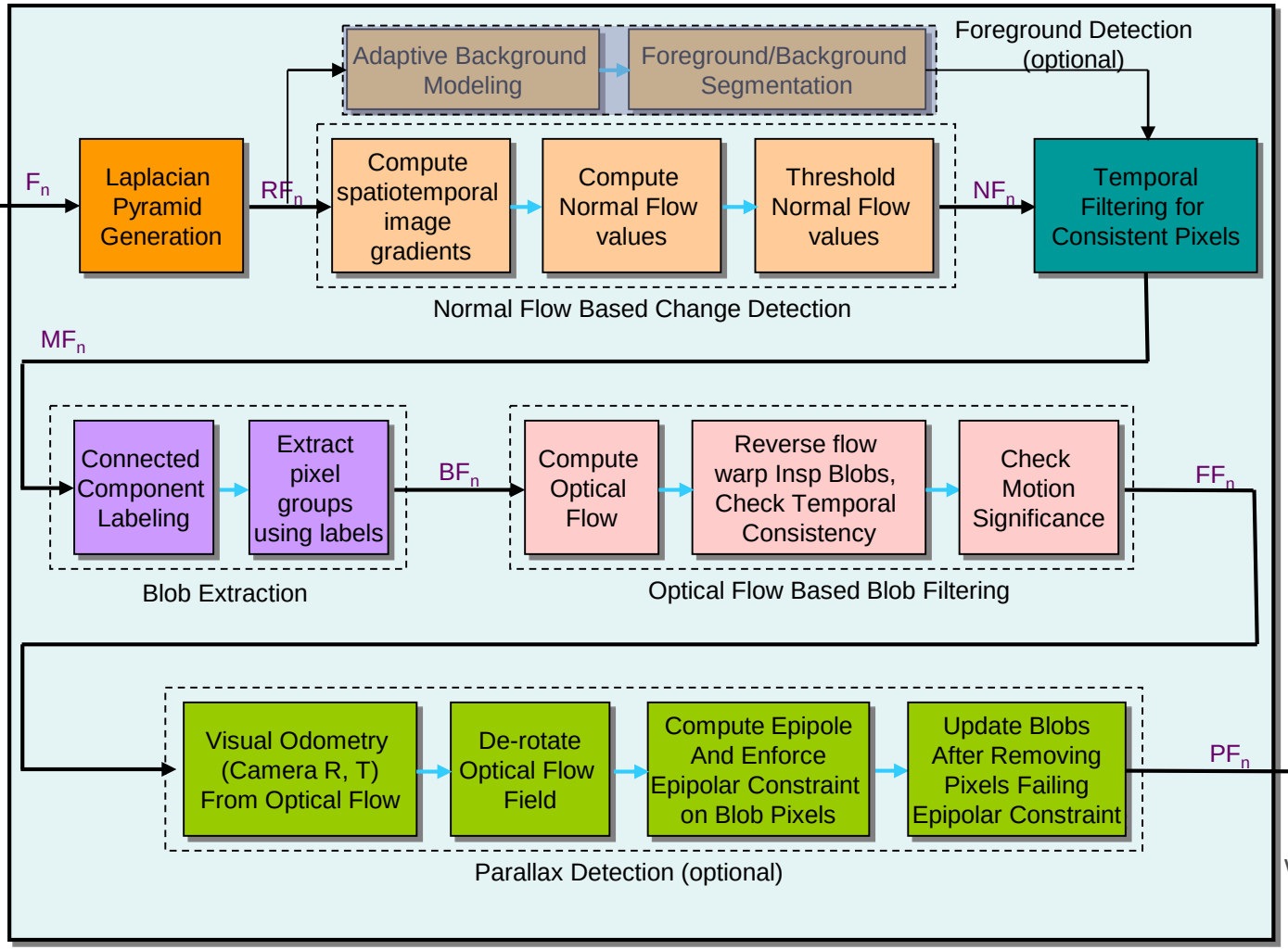
MTI parameters



Video frames (original) with moving target indications (VMTI imagery)

F_n: Histogram equalized frame w/ stab params
RF_n: Laplacian of F_n+ Stabilized ref frame
NF_n: F_n+ Binarized F_n of change pixels
MF_n: F_n+ Binarized F_n of consistent change pixels
BF_n: F_n+ Blobs of change pixels
FF_n: F_n + consistent blobs + Optical Flow Field
PF_n: F_n + consistent blobs (following Parallax Detection)

A conceptual modeling language that is

- simple yet expressive, and
- intuitive yet formal

Let the search begin!

Universal Ontology

Ontology: a set of concepts for describing a domain (industry, banking, military, botany, healthcare…) and systems within it.

Universal Ontology: a *domain-independent* set of concepts for describing systems in the universe, both natural and man-made.

Fundamental question 1:

What is needed to describe the universe?

Answer:

Describing the universe requires things and relations among them.

Question 2:

What **is** a thing

or

what can it **do**?

Answer:

A thing can either

exist

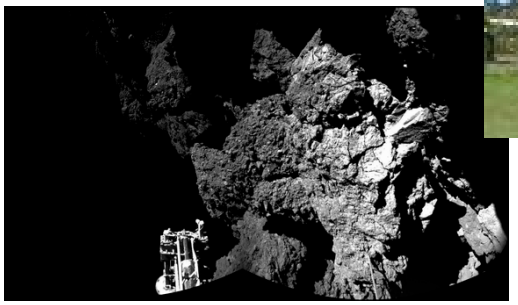
or

happen.

Any thing either **exists** or **happens** – nothing else!

Question 3:

What are the things that *exist* in the world?

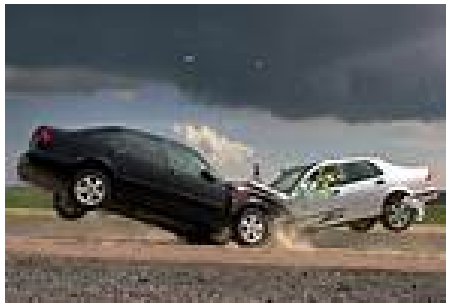


Answer:

Objects *exist.*

They are ***static*** *–*

time independent.



Question 4:

What are the things that ***happen*** in the world?

Answer:

Processes *happen.*

*They are **dynamic** – time dependent.*

Question 5:

How do **objects** and **processes** relate?

Answer:

Processes *happen* to **objects.**

While happening,

processes *transform* **objects.**

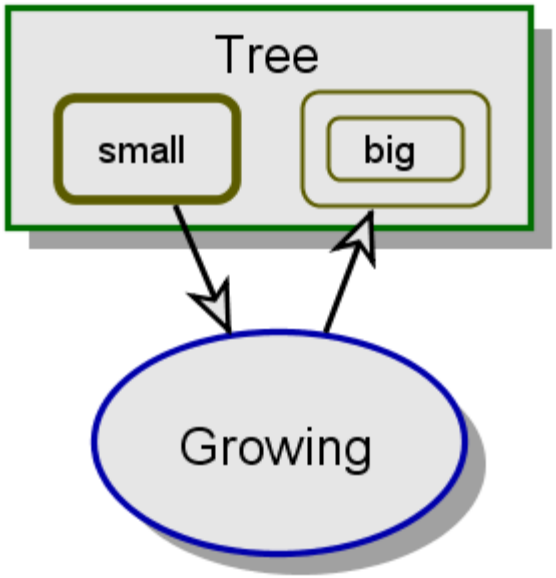
Question 6:

What does a **process** do when it happens to an **object**?

Answer:

The **process** *transforms* the **Object**.

OPM Things: Objects and Processes

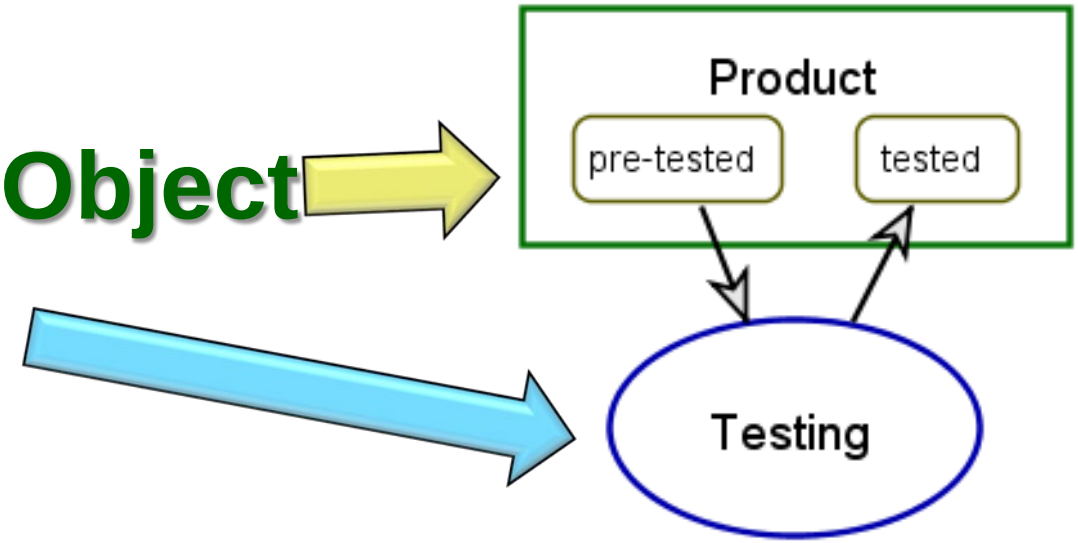


Object: A thing that exists or might exist physically or informatically.

Process: A thing that transforms one or more objects.

OPM's only two building blocks:

1. **Stateful Object**
2. **Process**



All the other elements are relations between things, expressed graphically as links.

processes *transform* objects.

Question 7:

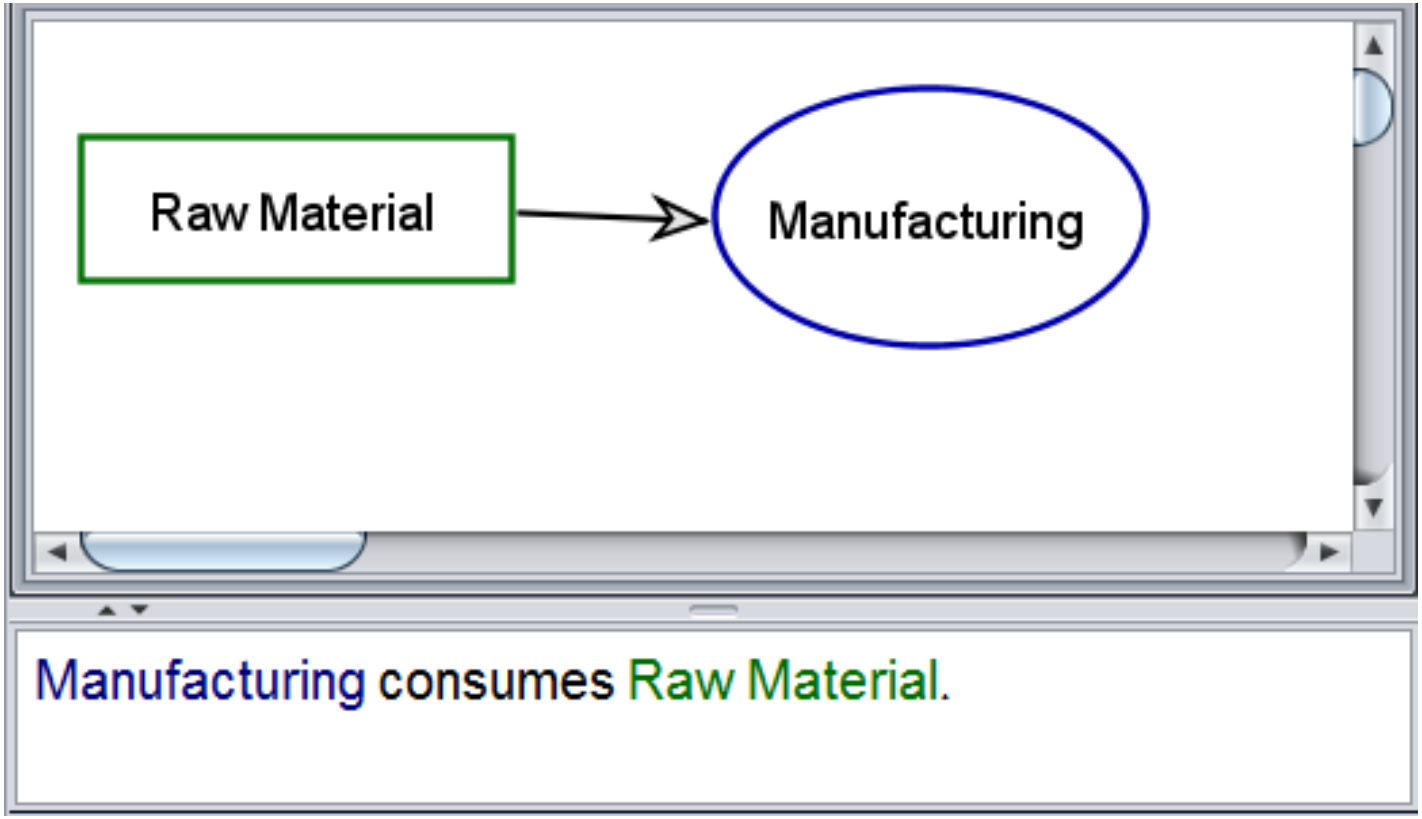
What does ***transforming*** mean?

Transforming means

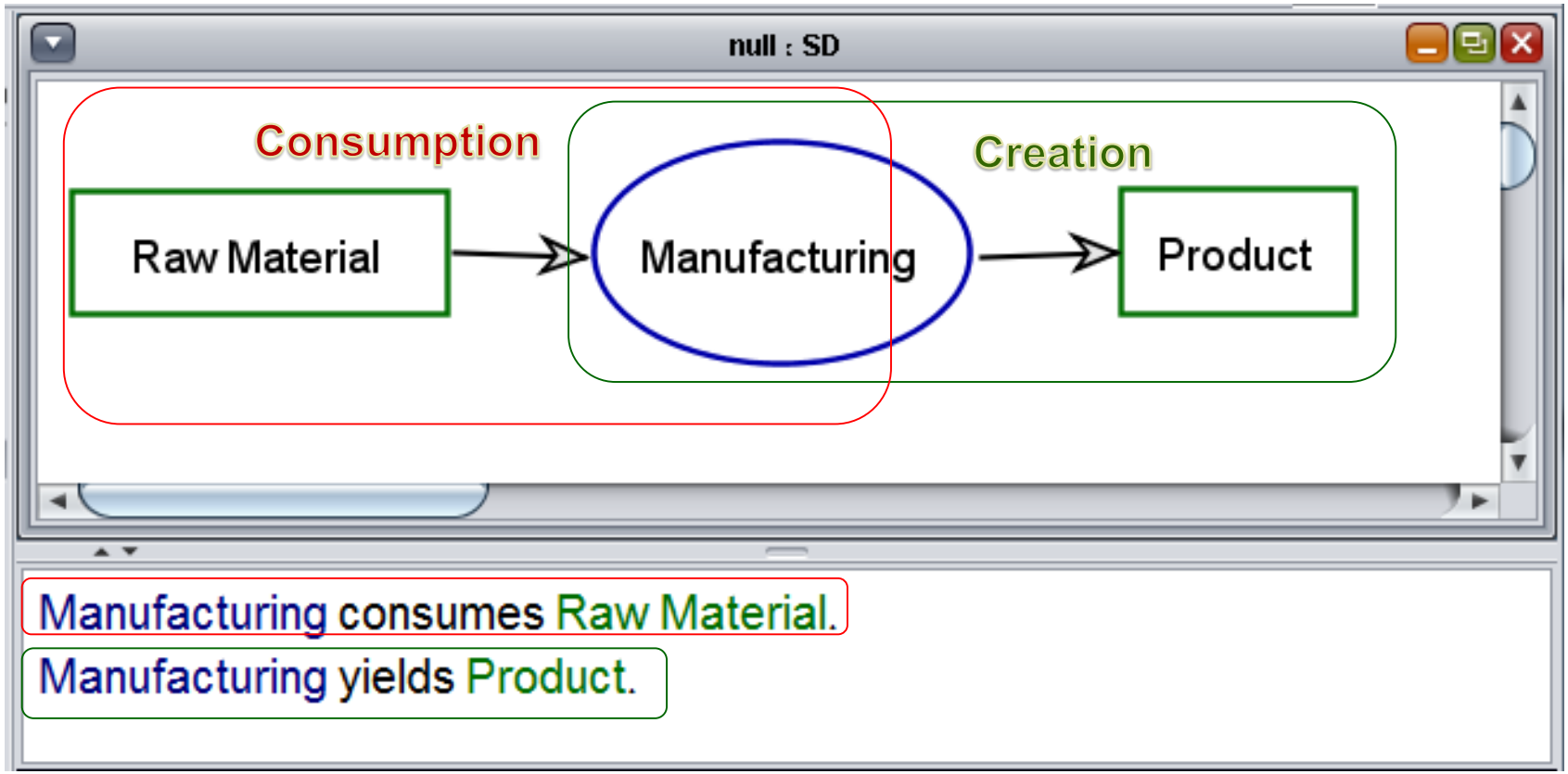
1. *creating* an object *or*
2. *destroying* an object *or*
3. *affecting* an object.

Transforming an object by a process can be done in three ways

(1) Process consumes the object



(2) Process creates the object



processes *affect* objects.

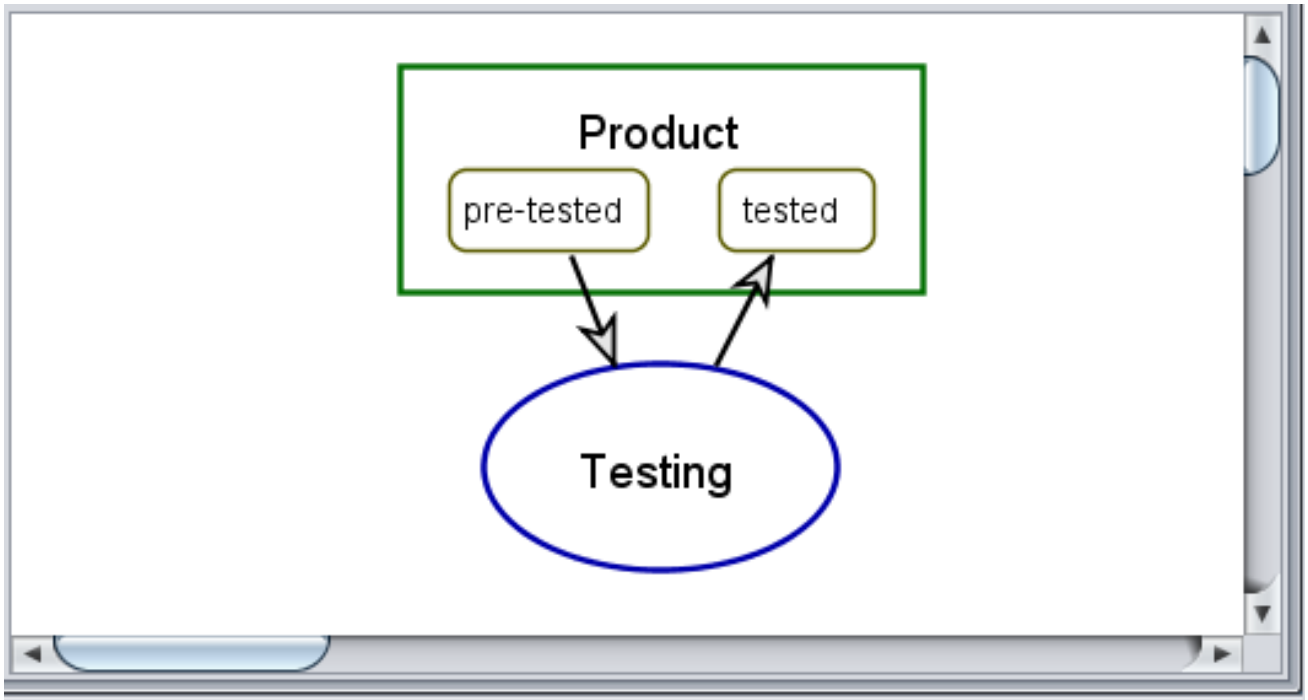
Question 8:

What does ***affecting*** mean?

- *A* **process** *affects* an **object** *by changing its* **state.**
- *Hence,* **objects** *must be* **stateful** *– they must have* **states.**

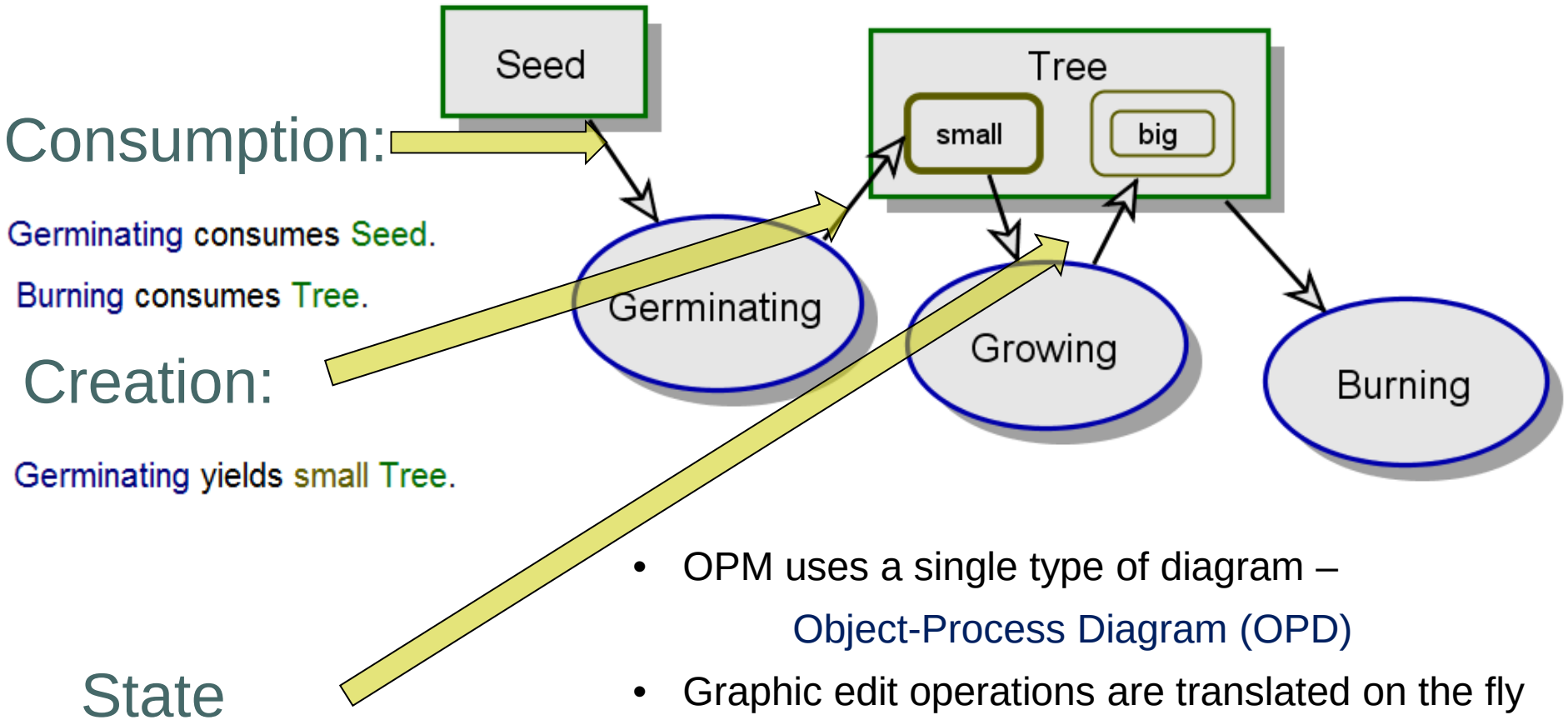
The third and last kind of object transformation:

(3) Process affects object by changing the object's state:



Product can be pre-tested or tested.
Testing changes Product from pre-tested to tested.

The three transformation kinds

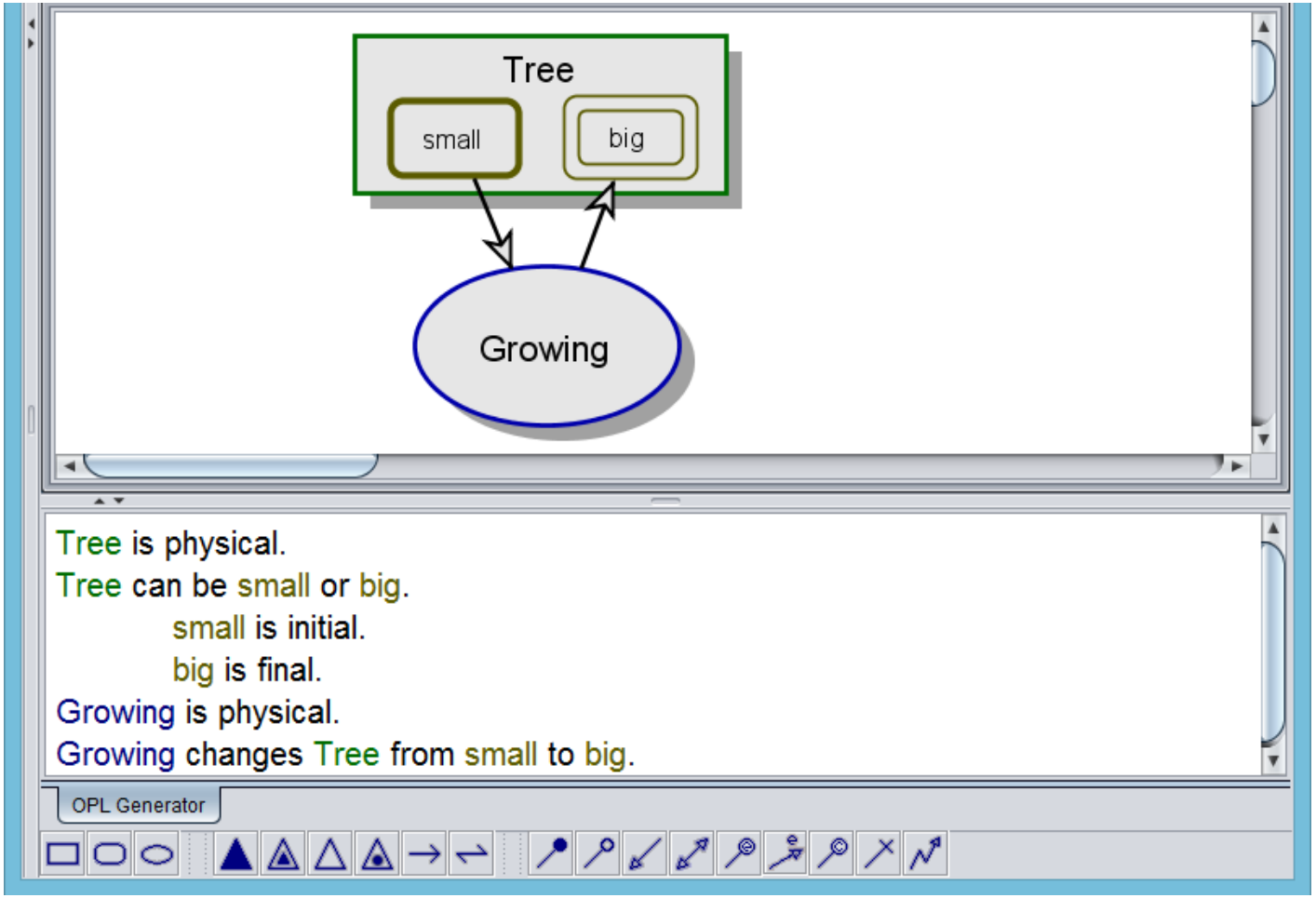


- OPM uses a single type of diagram –
  Object-Process Diagram (OPD)
- Graphic edit operations are translated on the fly to natural language –
  Object-Process Language (OPL)
- Catering to dual channel processing

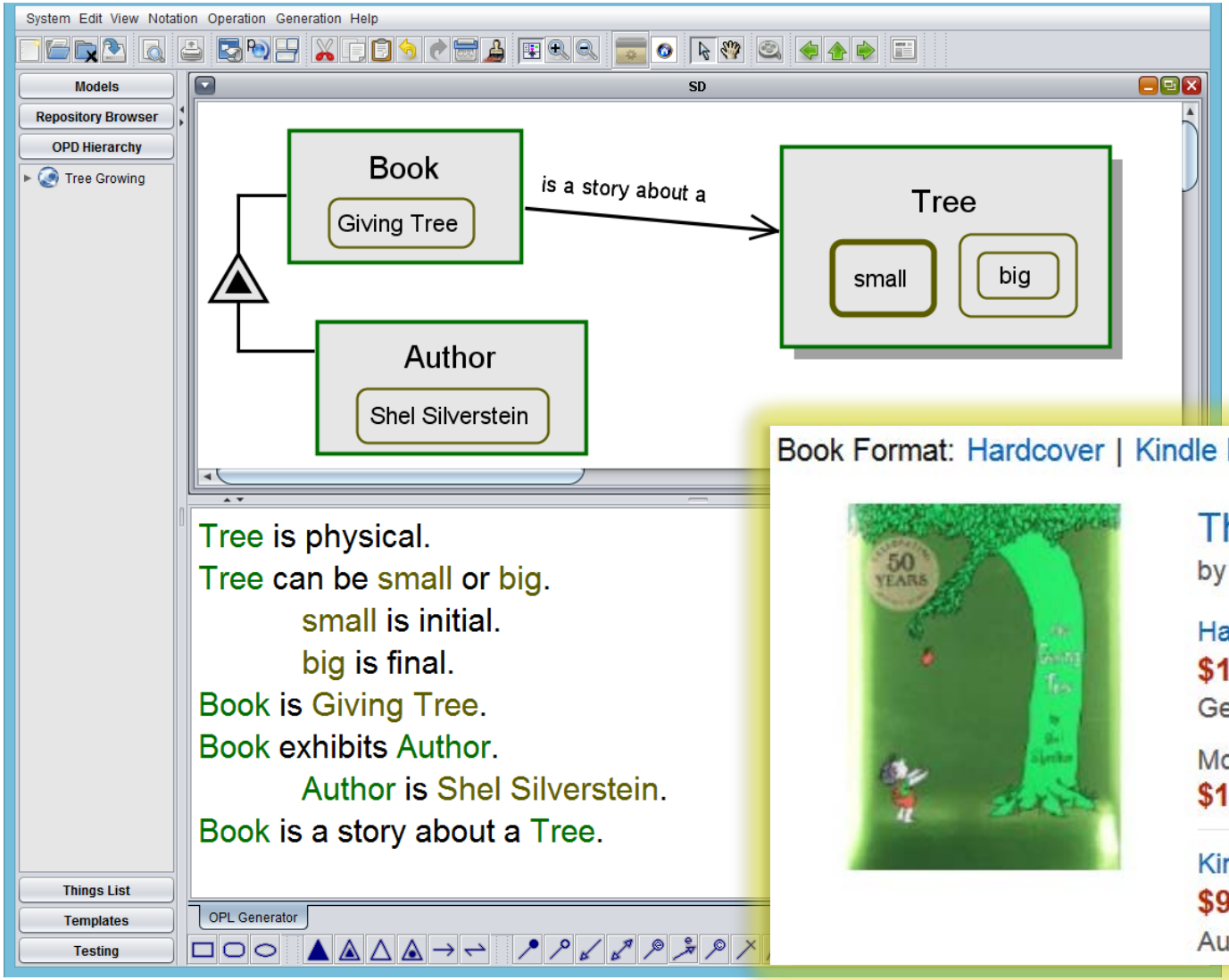
The graphics-text equivalence OPM principle

Any model fact expressed graphically in an OPD is also expressed textually in the corresponding OPL paragraph.

Caters to the dual channel cognitive assumption (Mayer, 2010)



Physical vs. Informatical Things



OPCAT – downloadable free from http://esml.iem.technion.ac.il/

Question 9: What are the two major aspects of any system?

- ***Structure*** – the static aspect:
  what the system is made of.
  - *Time-independent*
- ***Behavior*** – the dynamic aspect:
  how the system changes over time.
  - *Time-dependent*

Question 10:
What third aspect is specific to man-made systems?

- ***Function*** – the utilitarian, subjective aspect:
- ***Why*** is the system built?
- For ***whom*** is the system built?
- ***Who*** benefits from operating the system?

The Object-Process Theorem

Stateful objects, **processes**, and relations among them constitute a **necessary** and **sufficient universal ontology.**

Sample of engineering domains in which OPM has been used

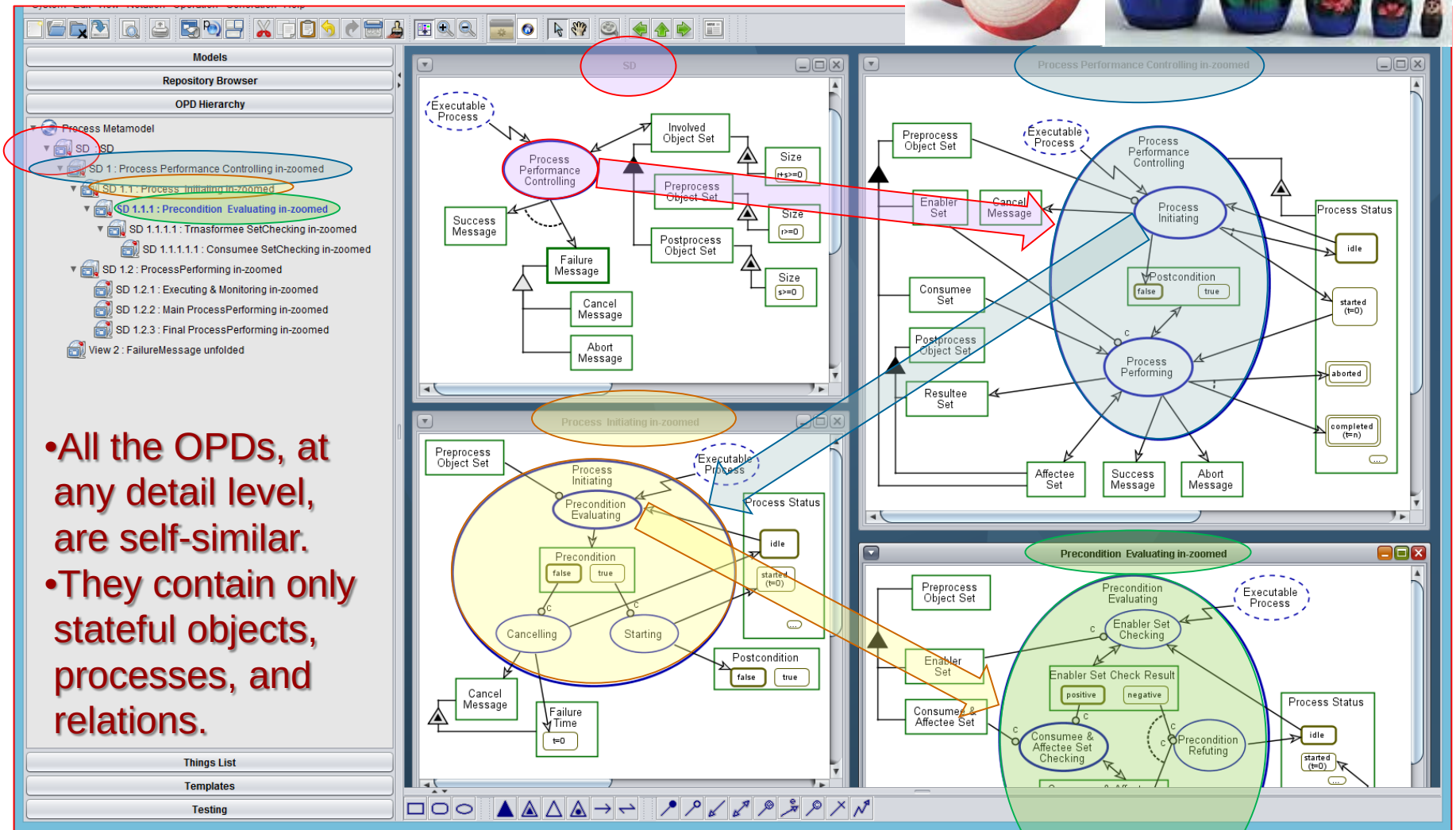
- **Complex, Interconnected, Large-Scale Socio-Technical Systems.** *Systems Engineering* 14(3), 2011.
- **Networking Mobile Devices and Computers in an Intelligent Home.** *International Journal of Smart Home* 3(4), pp. 15-22, October, 2009.
- **Multi-Agent Systems.** *IEEE Transactions on Systems, Man, and Cybernetics – Part C: Applications and Reviews*, 40 (2) pp. 227-241, 2010.
- **Semantic Web Services Matching and Composition.** *Web Semantics: Science, Services and Agents on the World Wide Web*. 9, pp. 16-28, 2011.
- **Project-Product Lifecycle Management.** *Systems Engineering*, 16 (4), pp. 413-426, 2013.
- **Model-Based Risk-Oriented Robust Systems Design.** *International Journal of Strategic Engineering Asset Management*, 1(4), pp. 331-354, 2013.
- **Medical Robotics and Miscommunication Scenarios.** An Object-Process Methodology Conceptual Model. *Artificial Intelligence in Medicine*, 62(3) pp. 153-163, 2014.
- **Modeling Exceptions in Biomedical Informatics**. *Journal of Biomedical Informatics 42*(4), pp. 736-747, 2009.

Complexity Management with OPM

- Systems are inherently complex.
- To alleviate this complexity, in OPM, it is managed by detail decomposition through three refinement-abstraction:
  - In-zooming – Out-zooming
  - Unfolding – Folding
  - State expression – suppression.

In-zooming – Out-zooming Example

Process Performance Controlling
- a metamodel from ISO 19450



- All the OPDs, at any detail level, are self-similar.
- They contain only stateful objects, processes, and relations.

Back to OSRVT – Moving Target Indicator: What is the Function of this system?

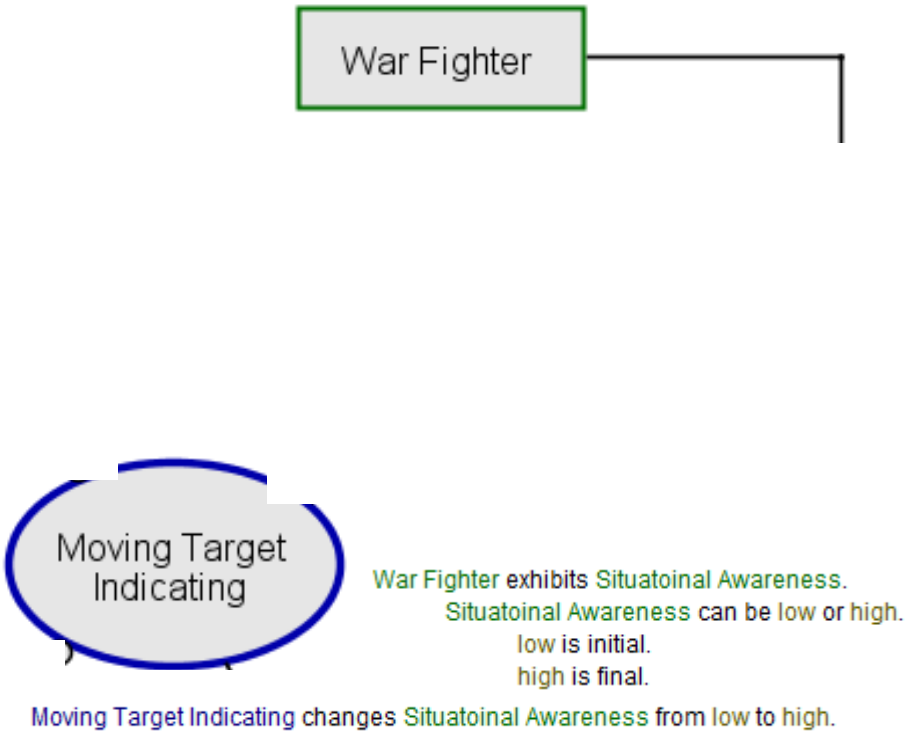
- Describe in three words, the last being a verb ending with ing (gerund)
- This will be our starting point of the OPM model

The Function:
Moving Target Indicating

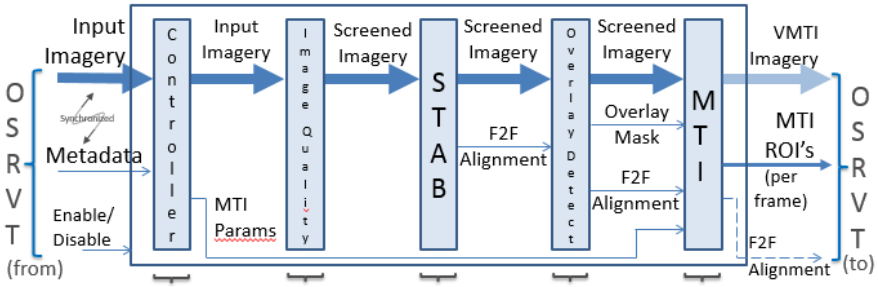
Who is the Beneficiary?

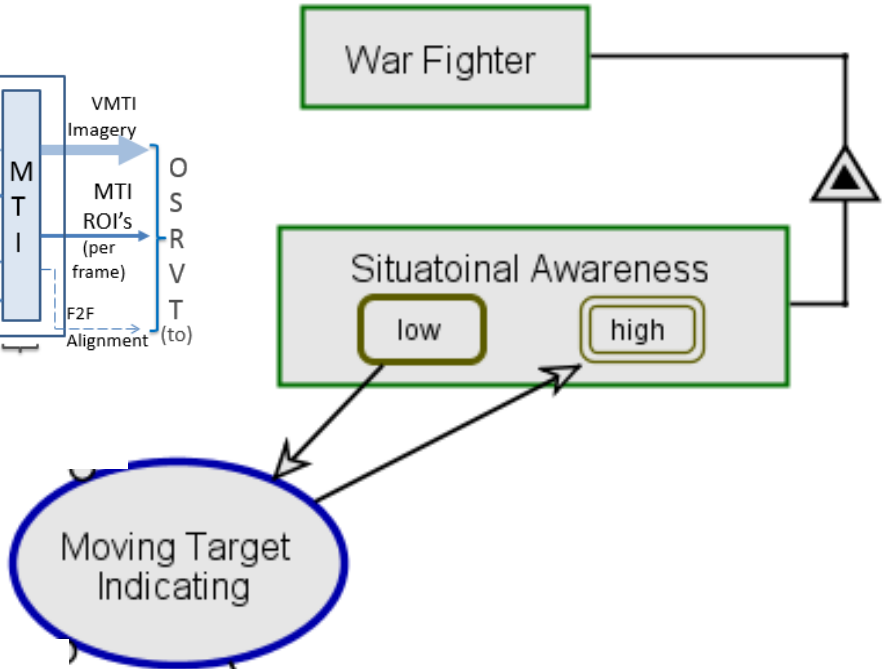
Who benefits from operating the system?

What attribute of War Fighter changes value by operating the system, such that benefit is created?

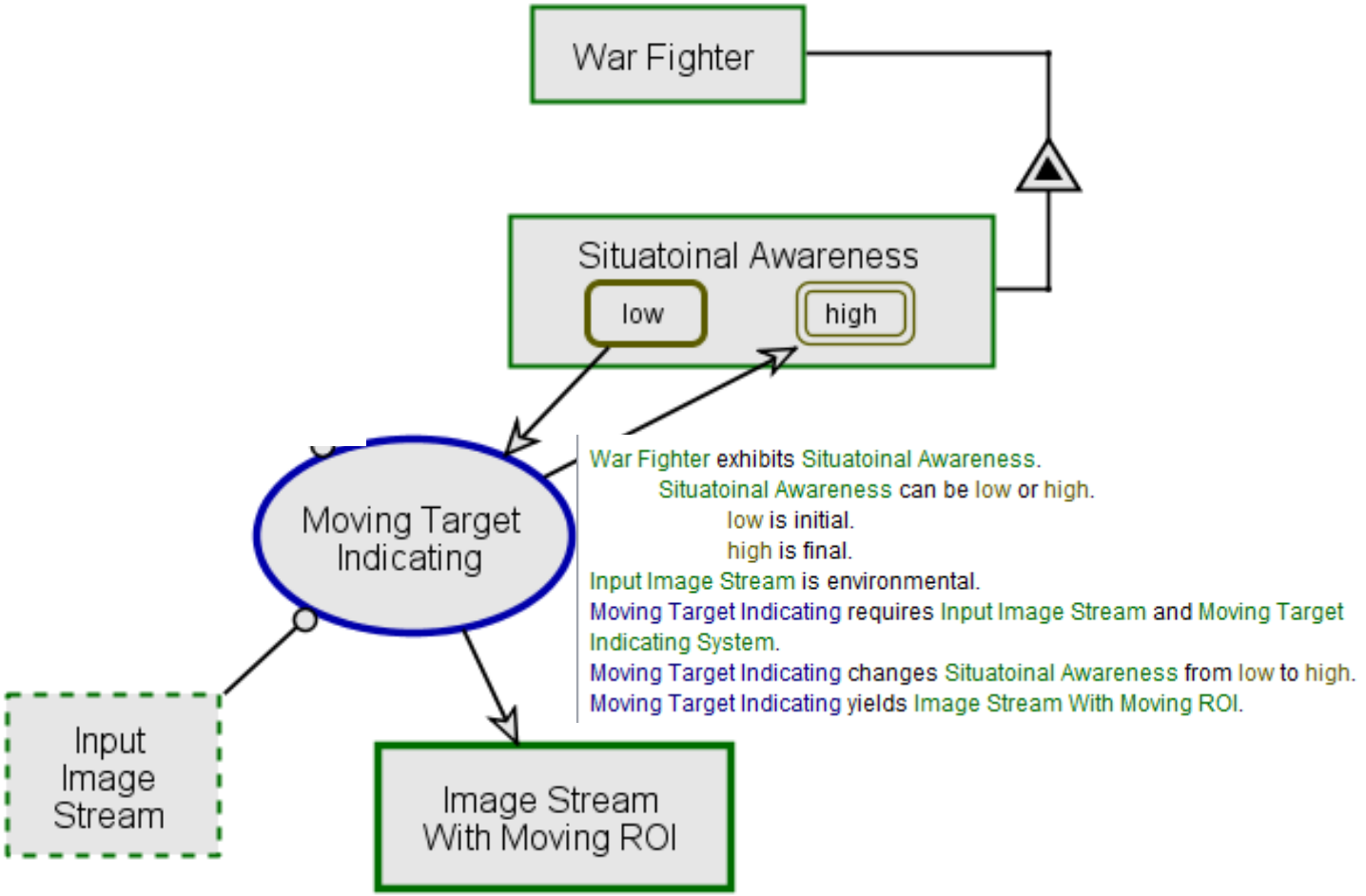


What are the system's input and output?

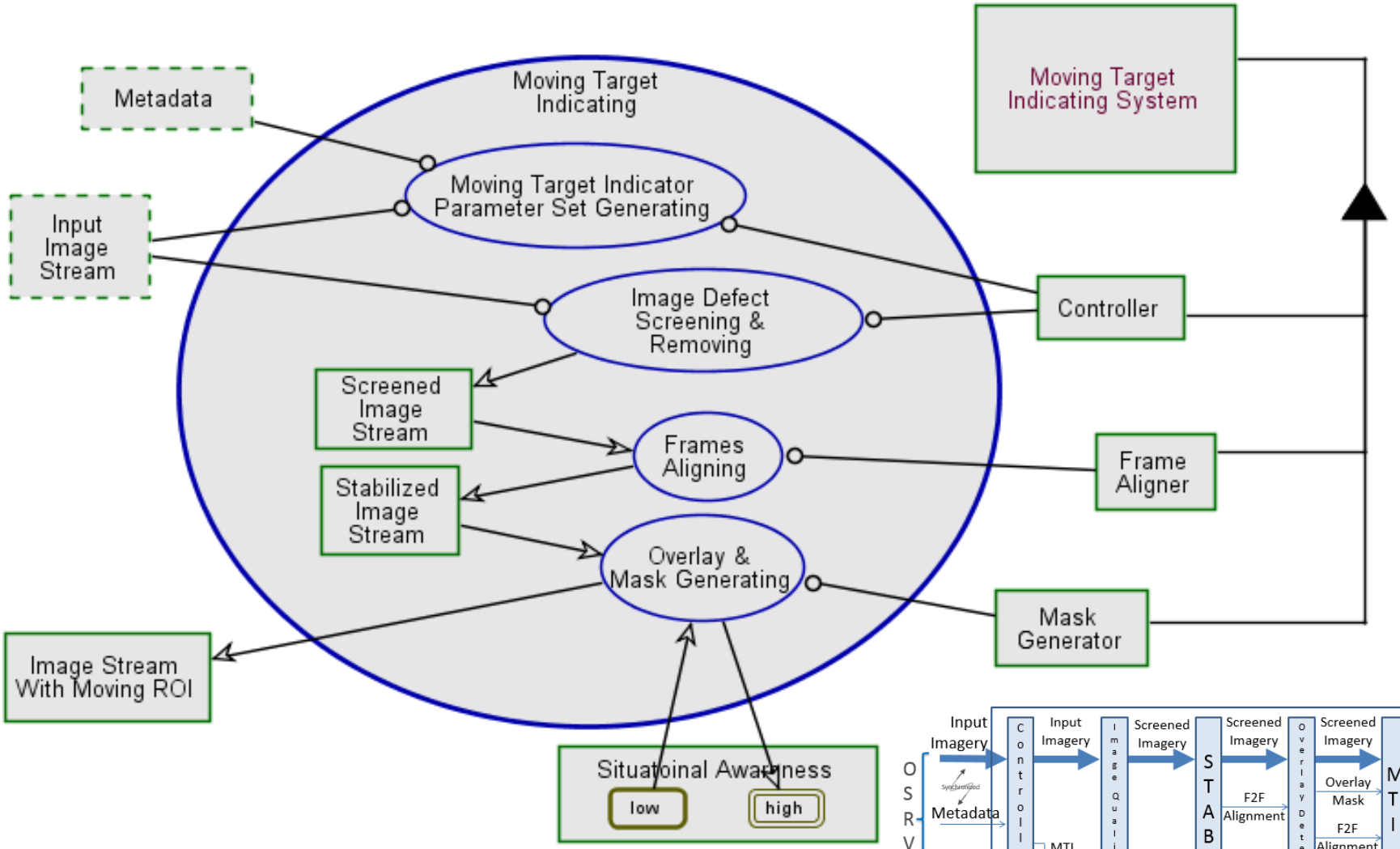




What is the name of the system we are developing?



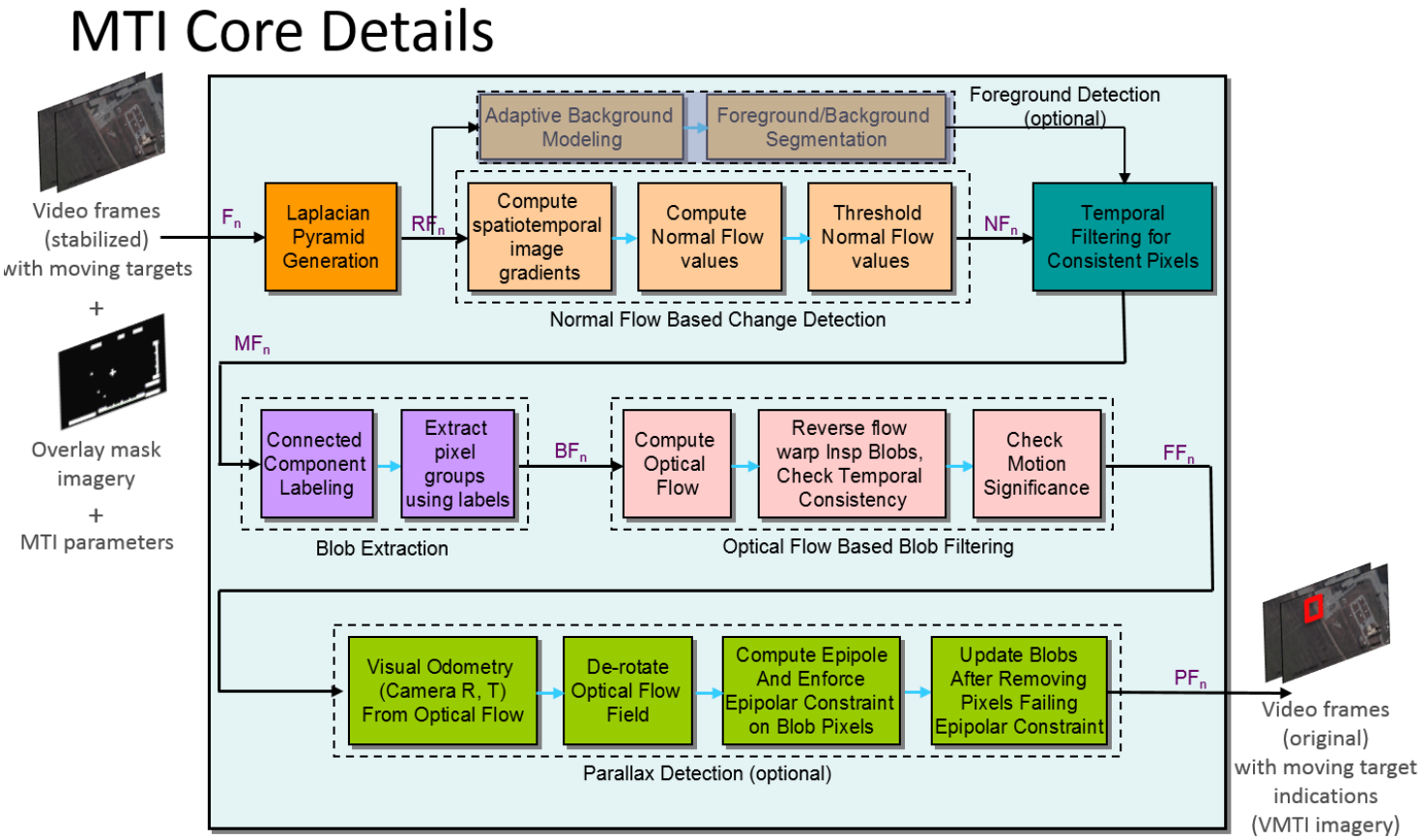
The next detail level: Zooming into the *Moving Target Indicating* Function



The Auto-Generated OPL Text: A self-documenting feature

Moving Target Indicating System consists of Controller, Frame Aligner, and Mask Generator.
Situatoinal Awareness can be low or high.
    low is initial.
    high is final.
Input Image Stream is environmental.
Metadata is environmental.
Moving Target Indicating exhibits Screened Image Stream and Stabilized Image Stream.
Moving Target Indicating consists of Moving Target Indicator Parameter Set Generating, Image Defect Screening & Removing, Frames Aligning, and Overlay & Mask Generating.
Moving Target Indicating zooms into Moving Target Indicator Parameter Set Generating, Image Defect Screening & Removing, Frames Aligning, and Overlay & Mask Generating, as well as Stabilized Image Stream and Screened Image Stream.
    Moving Target Indicator Parameter Set Generating requires Input Image Stream, Controller, and Metadata.
    Image Defect Screening & Removing requires Input Image Stream and Controller.
    Image Defect Screening & Removing yields Screened Image Stream.
    Frames Aligning requires Frame Aligner.
    Frames Aligning consumes Screened Image Stream.
    Frames Aligning yields Stabilized Image Stream.
    Overlay & Mask Generating requires Mask Generator.
    Overlay & Mask Generating changes Situatoinal Awareness from low to high.
    Overlay & Mask Generating consumes Stabilized Image Stream.
    Overlay & Mask Generating yields Image Stream With Moving ROI.

The Next Level of Detail will be based on this:



Summary: OPM Aspect Unification

The three system aspects:

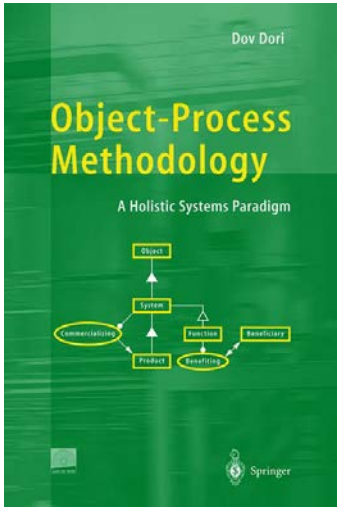
- ***Function*** (***why*** the system is built),
- ***Structure*** (static aspect: ***what*** is the system made of), and
- ***Behavior*** (dynamic aspect: ***how*** the system changes over time)

- Are expressed bi-modally, in graphics and equivalent text
- In a **single** model

Agile OPM-MBSE Highlights

- **Model the requirements *together with the customer***
- Use this model as a basis for ***concept generation*** and their evaluation and ***selection of best one***
- Achieve ***shared understanding and agreement*** of multidisciplinary engineering team
- ***Communicate*** the solution model ***with the customer***
- ***Evolve and use the model across all the system lifecycle***: detailed design, integration, testing, deployment, maintenance, retirement…

OPM Resources:



- Book: Object-Process Methodology - A Holistic Systems Paradigm, Springer Verlag, Berlin, Heidelberg, New York, 2002.
- Upcoming book (2015) Model-Based Systems Engineering with OPM and SysML, Springer, New York.
- Standard ISO/PAS 19450 OPM
- Website: Enterprise Systems Modeling Laboratory contains
  - journal & conference papers,
  - free OPCAT software,
  - presentations,
  - projects, and more.

Appendix: SysML and OPM – a brief comparison

Feature	SysML	OPM
Theoretical foundation	UML; Object-Oriented paradigm	Minimal universal ontology; Object-Process Theorem
Standard documentation number of pages	1670 (700 + 700 + 270)	130 (100 + 30)
Standardization body	OMG (2006)	ISO (2014)
Number of diagram kinds	9	1
Graphic modality	yes	yes
Textual modality	no	yes
Physical-informatical distinction	no	yes
Systemic-environmental distinction	no	yes

Join the growing OPM community Here!

https://www.jiscmail.ac.uk/cgi-bin/webadmin?SUBED1=OPM&A=1

Questions and (hopefully) Answers

Contact: Dov Dori – dori@mit.edu

Agile System Modeling and Lifecycle Engineering with Object-Process Methodology

Discussion Things to Think About

- What might be compelling reasons to try OPM, even if you are already using SysML?
- Does SysML satisfy your needs for communicating concept models to management?
- What needed capability does SysML provide that OPM doesn't satisfy?
- Is OPM more agile than SysML? Why might that matter?
- Have you got a simple-project test for OPM, to try it out?

Please

The link for the online survey for this meeting is

www.surveymonkey.com/r/08_12_15_enchantment

www.surveymonkey.com/r/08_12_15_enchantment

Look in GlobalMeet chat box for cut & paste link.

Slide presentation can be downloaded now/anytime from:

The library page at: www.incose.org/enchantment

Recording will be in library tomorrow.