

# On the suitability of correctness criteria for business process models

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# Need for Different Correctness Criteria

There are many steps from the first modeling of processes to their execution support at run time through a WFMS.

Finally, the process specifications must be **sound** to guarantee smooth execution.

However, on the way towards a sound specification **less strict abstraction levels** should be supported.

# Soundness

- no deadlocks, no livelocks
- every tasks contributes to the workflow process

in terms of Petrinets (WF-nets):

- every execution path starting in  $i$  will end in  $o$  (**proper termination**)
- there are no dead transitions (**no dead tasks**)

[HSV04]

# Soundness

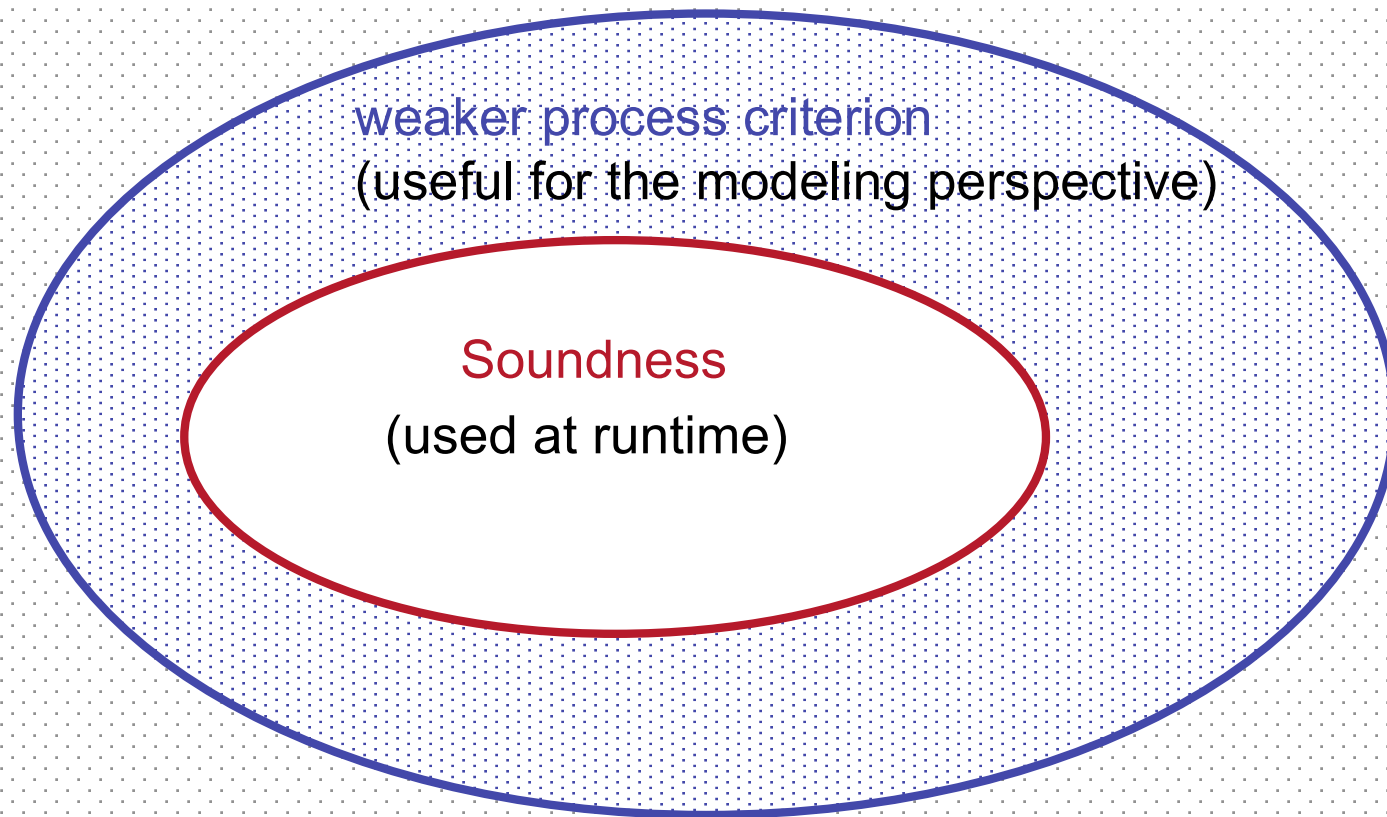
## **Advantages:**

- guarantees smooth execution of the workflow processes at runtime

## **Disadvantages:**

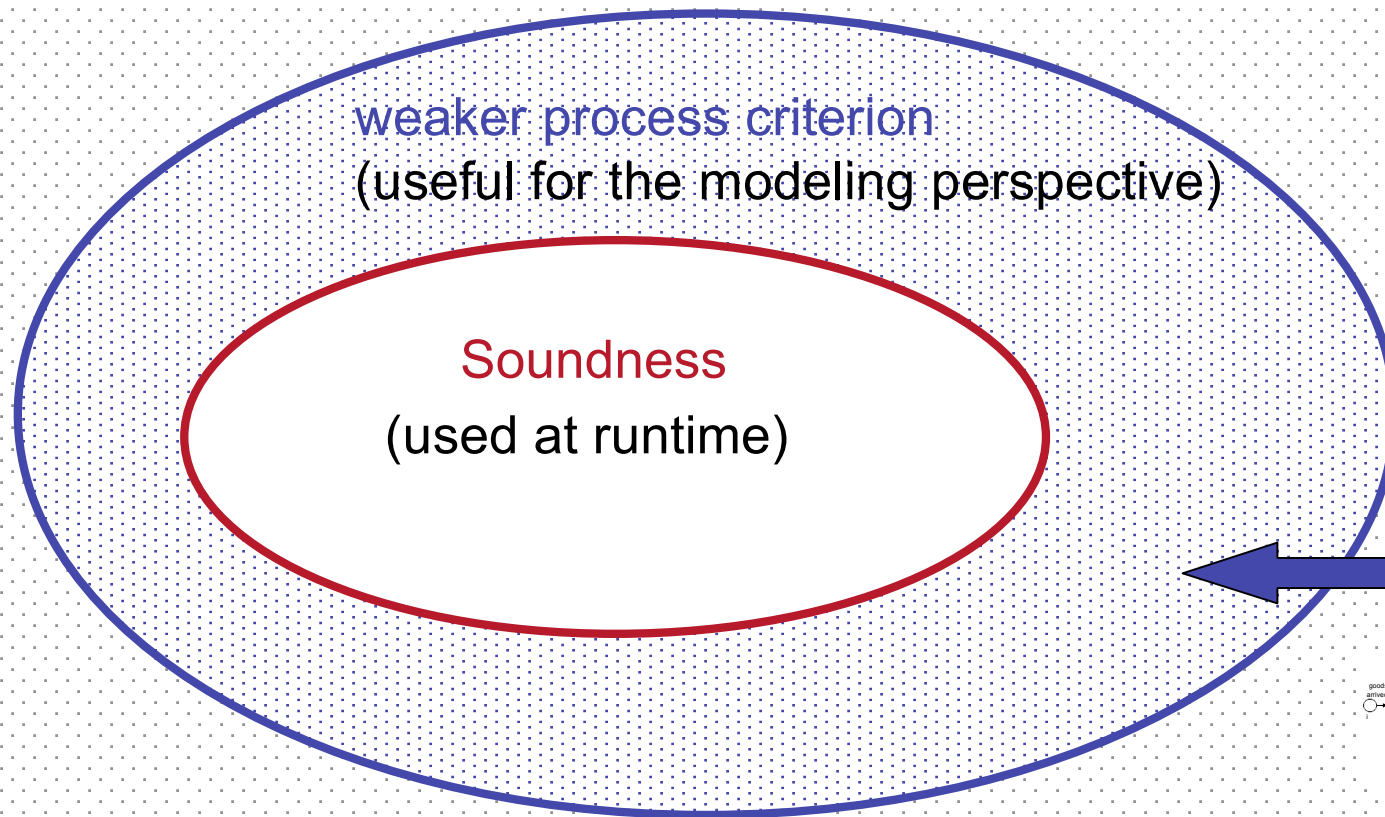
- hard to see for modelers, • need to overview the entire behavior, • failure messages are sometimes hard to interpret

# Demands on a Weaker Criterion



process descriptions  
containing serious failures

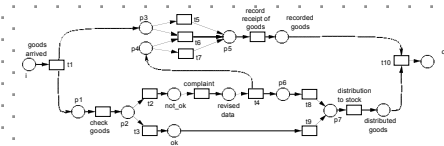
# Demands on a Weaker Criterion



weaker process criterion  
(useful for the modeling perspective)

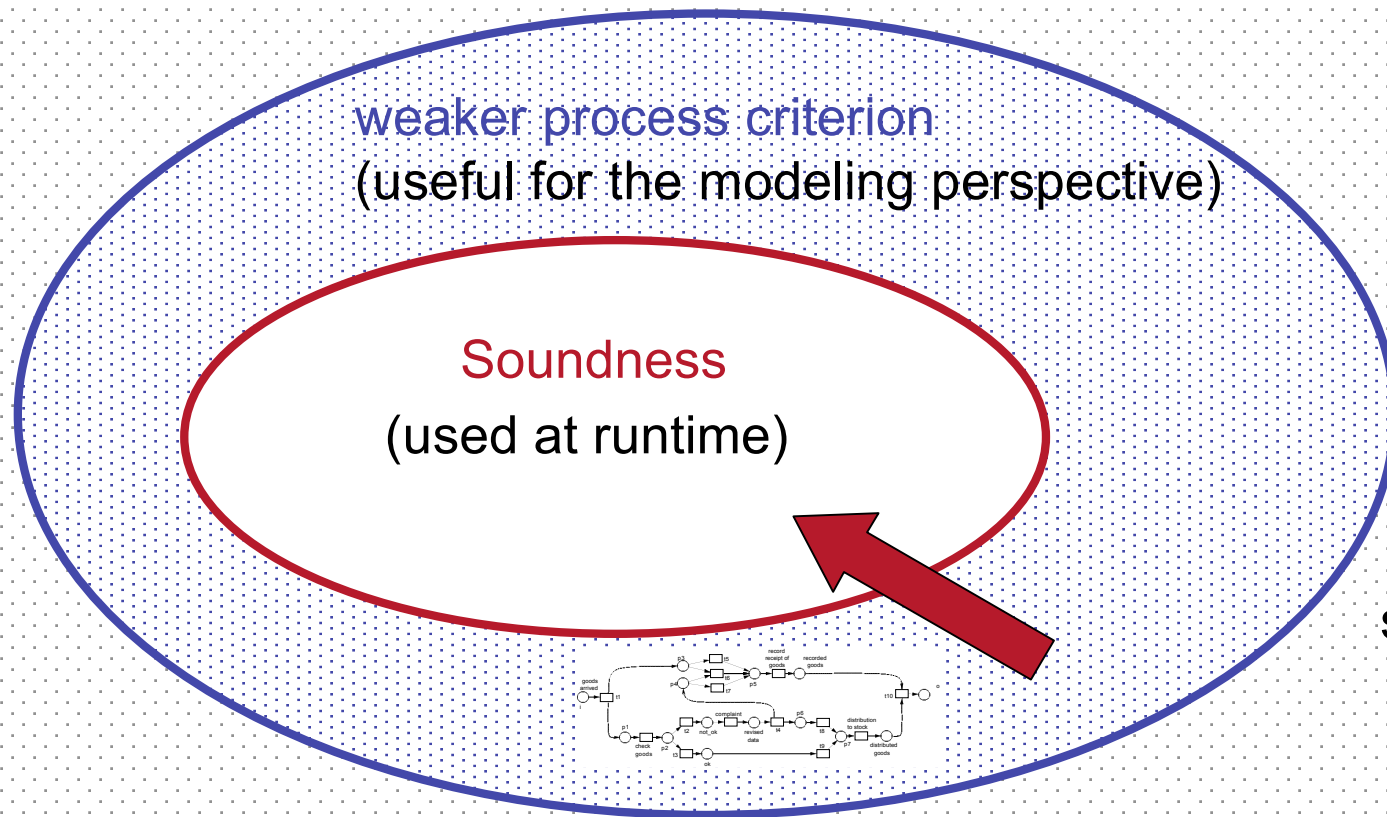
Soundness  
(used at runtime)

transformation  
cannot be done  
automatically, but  
needs human  
modeling  
expertise



process descriptions  
containing serious failures

# Demands on a Weaker Criterion



# Alternatives on the Model Level

## Well-Structuredness

- strict blockstructuring, i.e. every split is followed by a corresponding join

( In terms of Petrinets:  
the net is well-handled, i.e.  
there are no  
Transition/Place- and no  
Place/Transition-handles )

## Relaxed Soundness

- “enough” sound executions, i.e. every transition occurs in a run that starts in  $i$  and ends in  $o$



# Well-Structuredness

## **Advantages:**

- provides strict guidelines for the modeling

## **Disadvantages:**

- hierarchical design may inhibit modeling along the organizational structure
- supports only basic WF-pattern

# Relaxed Soundness

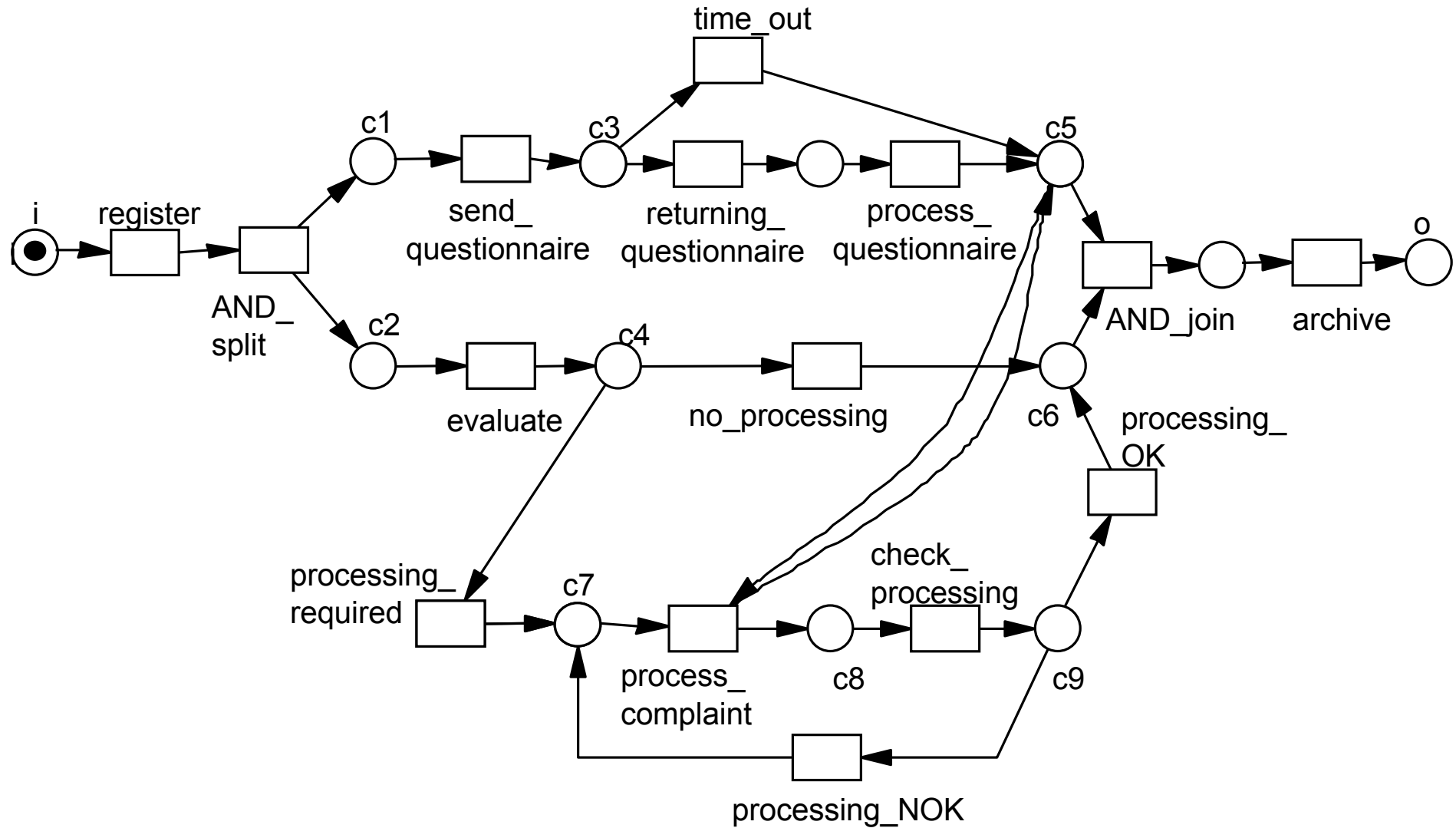
## **Advantages:**

- intuitive modeling, as modelers can describe their processes as they experience them --  
``first happens this,... then that,...then it is waited on the result of ... ``
- precise failure feedback
- advanced WF-pattern are supported

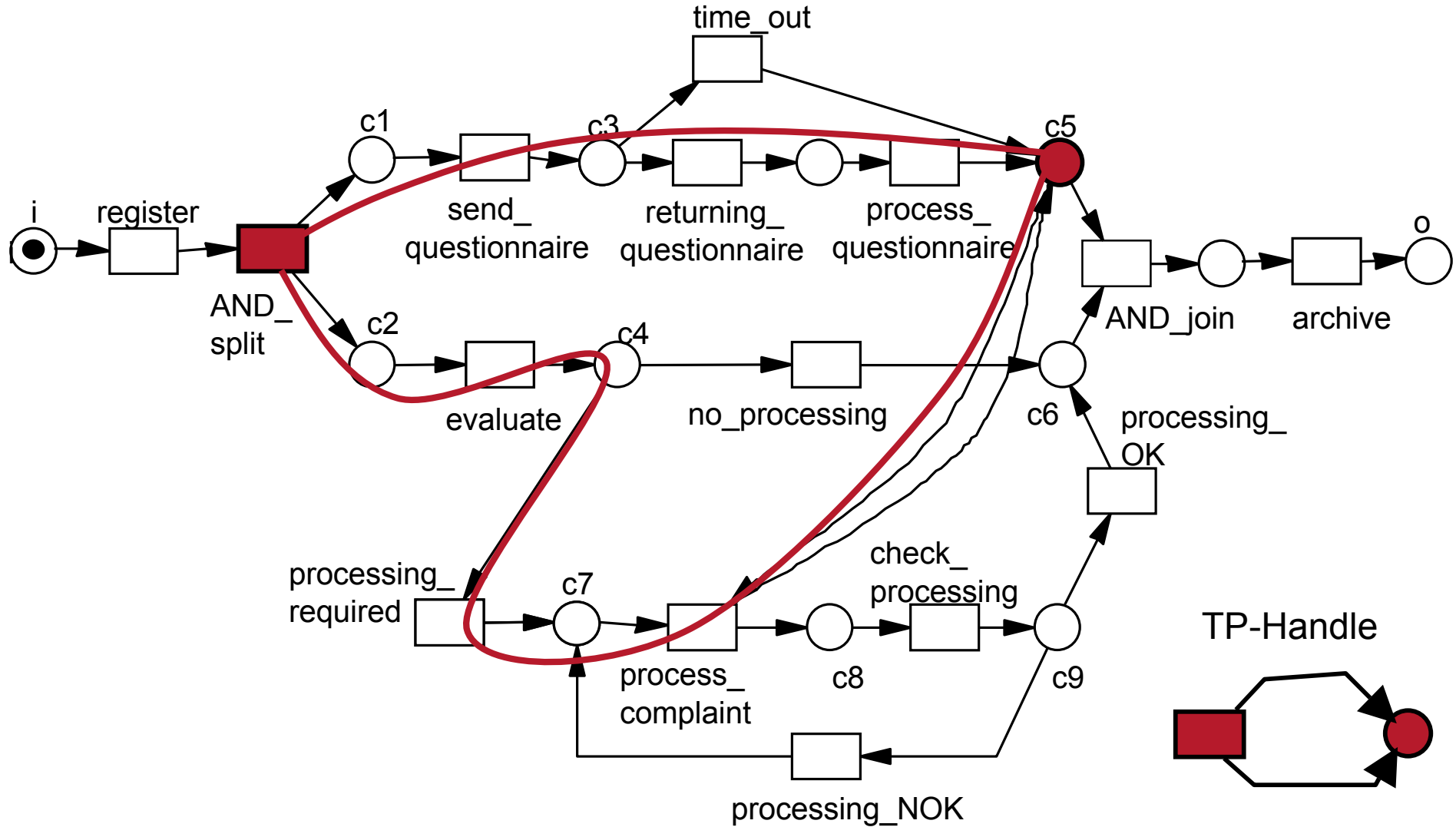
## **Disadvantages:**

- deadlocks and/or livelocks are possible
- no structural criterion

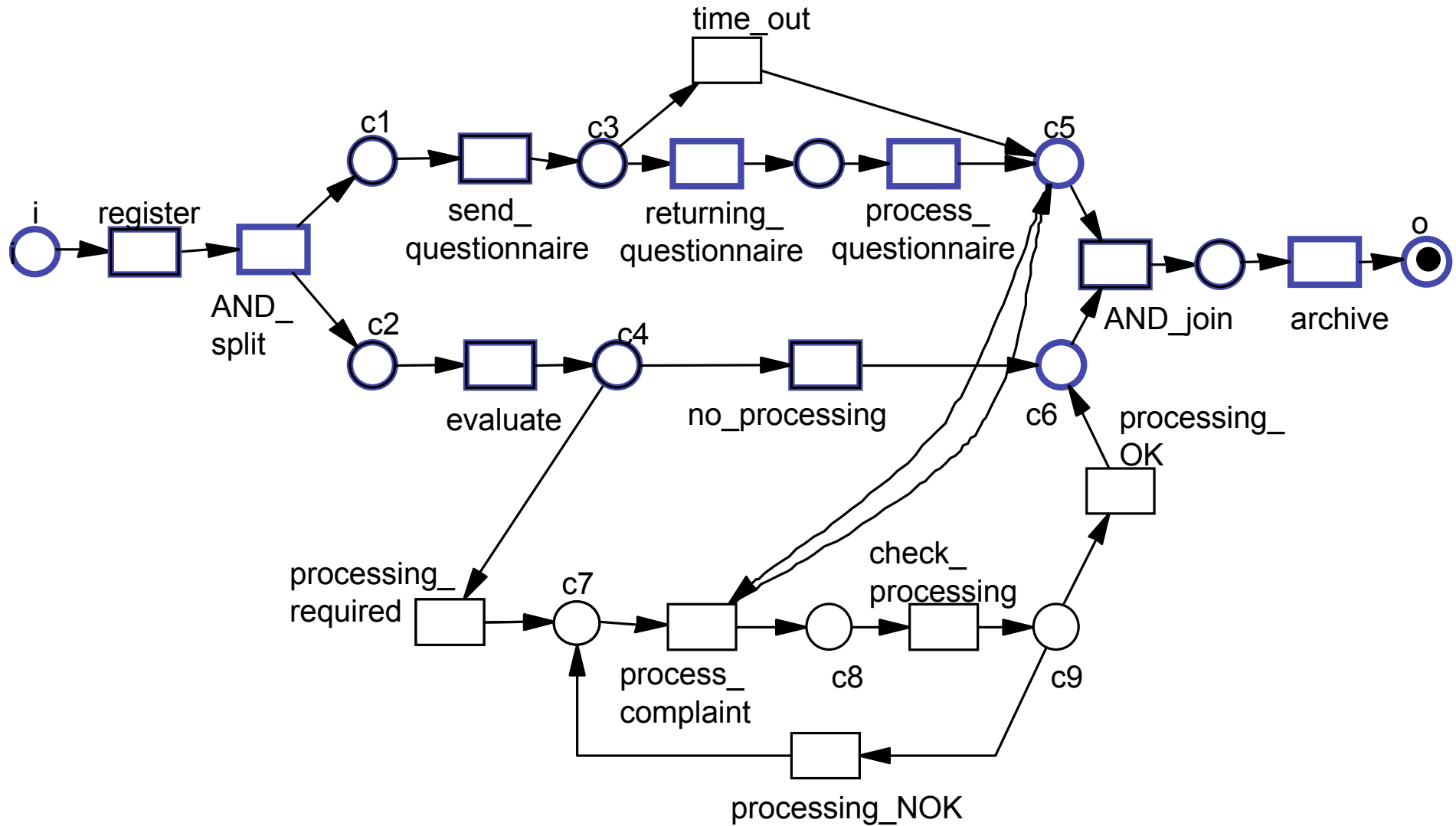
# Example WF-net [Aal98]



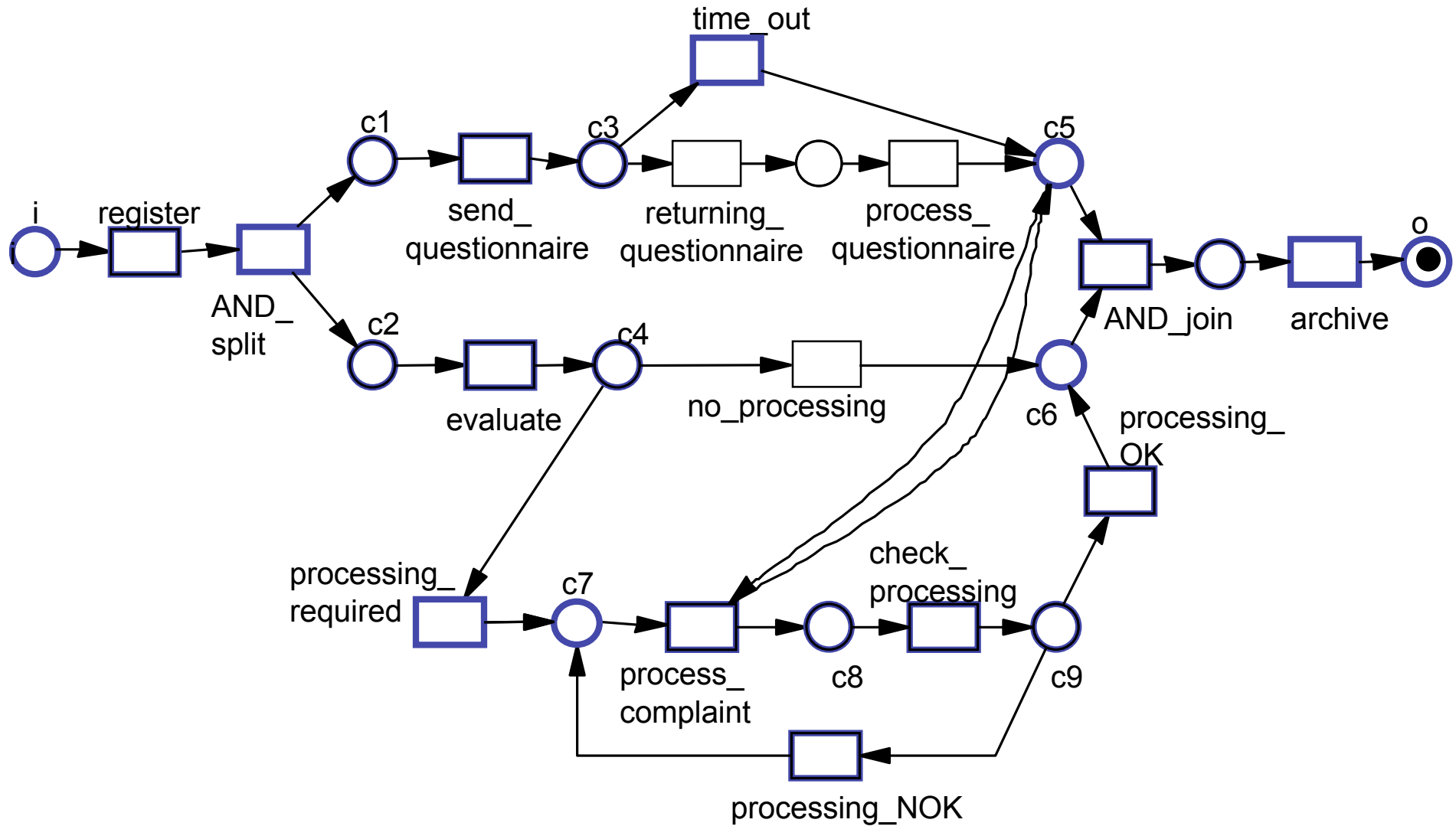
# Not Well-Structured



# Relaxed Sound



# Relaxed Sound



# Relations Between the Properties

soundness  $\not\rightarrow$  well-structuredness

## Consequence:

- some useful (sound!) WF-processes are disregarded right from the beginning

# Relations Between the Properties

well-structuredness  $\not\rightarrow$  soundness

but well-structuredness and liveness  $\longrightarrow$  soundness

## Consequence:

soundness check of a well-structured WF-net can be done in polynomial time [Aal00]

## Transformation? ✓

A well-structured net which is not sound only needs the right initial marking to become sound.



# Relations Between the Properties

soundness  $\longrightarrow$  relaxed soundness

## **Consequence:**

no sound WF-processes are disregarded already  
during the modeling

# Relations Between the Properties

relaxed soundness  $\not\rightarrow$  soundness

## Transformation?

a relaxed sound net (which is not sound) can be made sound, inserting controller places which inhibit failure prone behavior

# Relations Between the Properties

relaxed soundness  $\not\rightarrow$  soundness

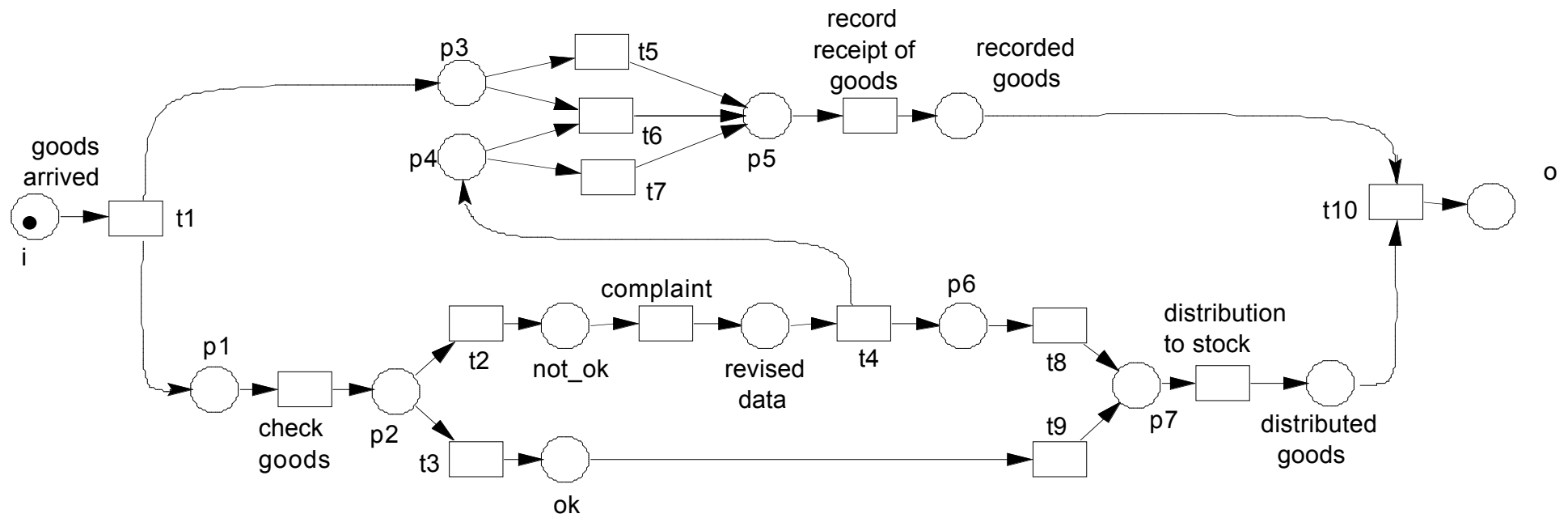
## Consequence:

No benefit for the soundness check, as relaxed soundness cannot be decided based on the process structure.

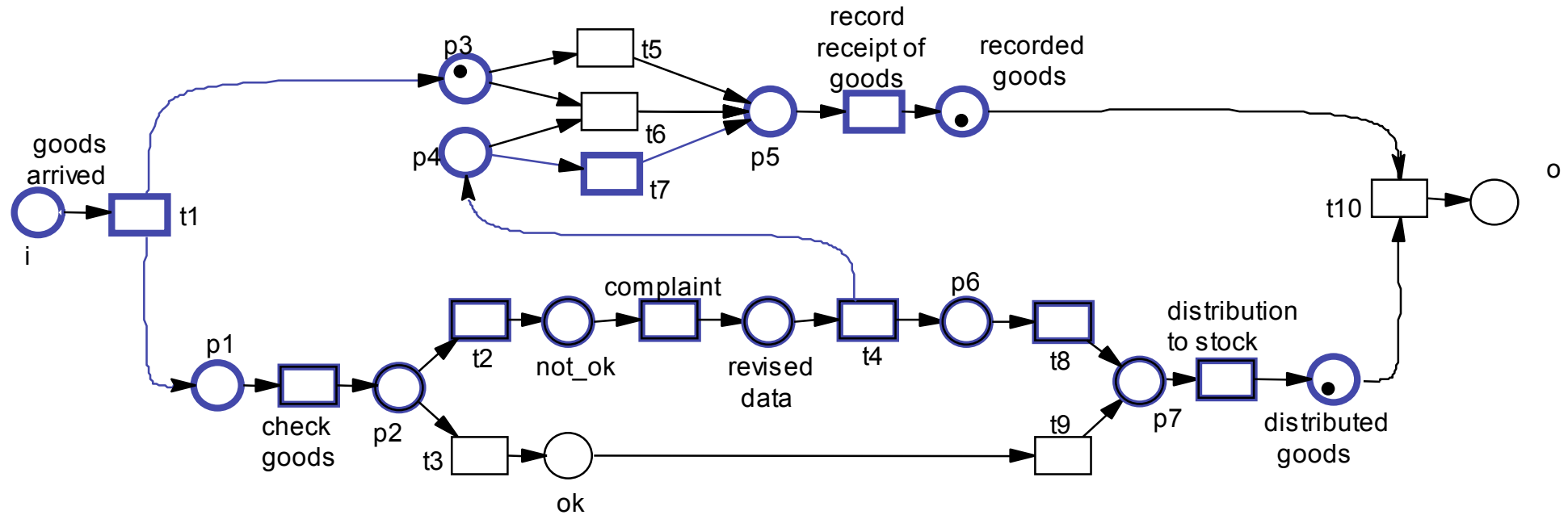
## Transformation? ✓

A relaxed sound net which is not sound can be made sound by inserting controller places which inhibit deadlocks [DeAa04].

# Another Example

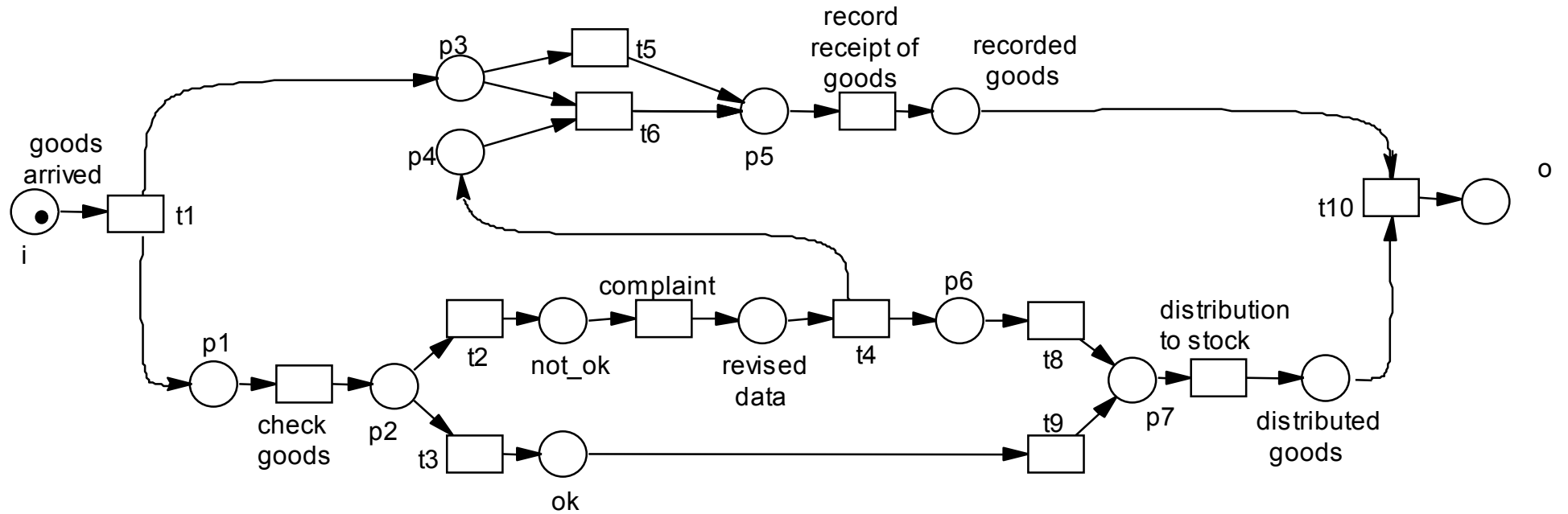


# Not Relaxed Sound

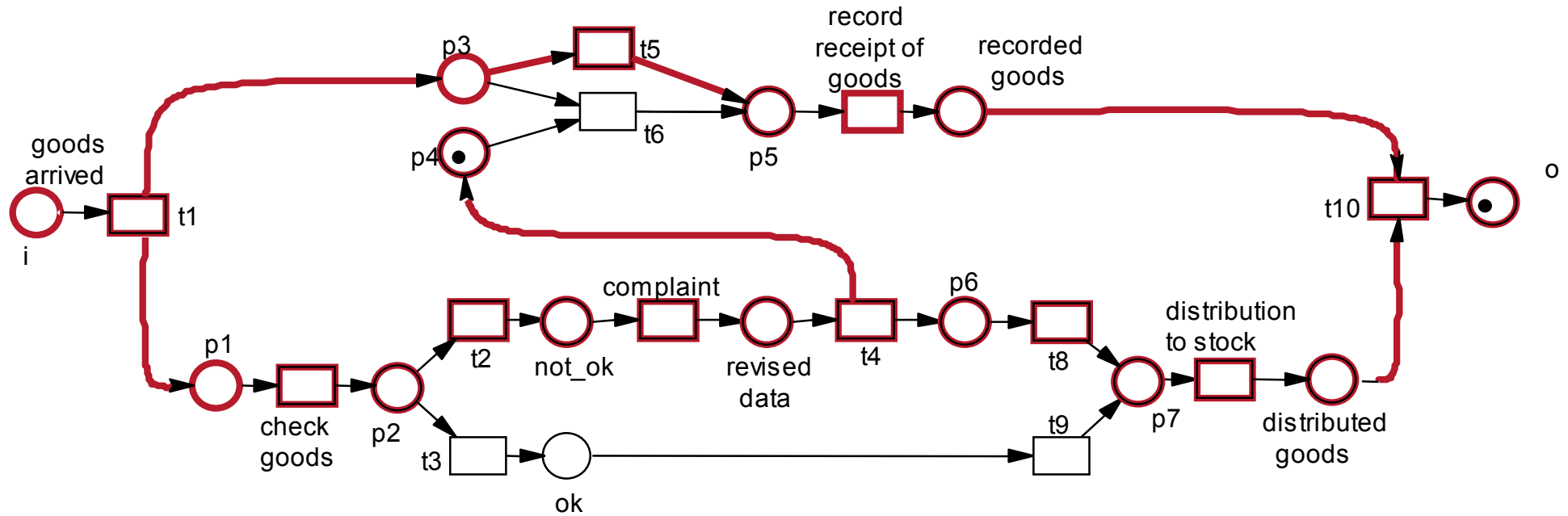


Failure Feedback: There is no sound run containing task t7.

# Revised Model

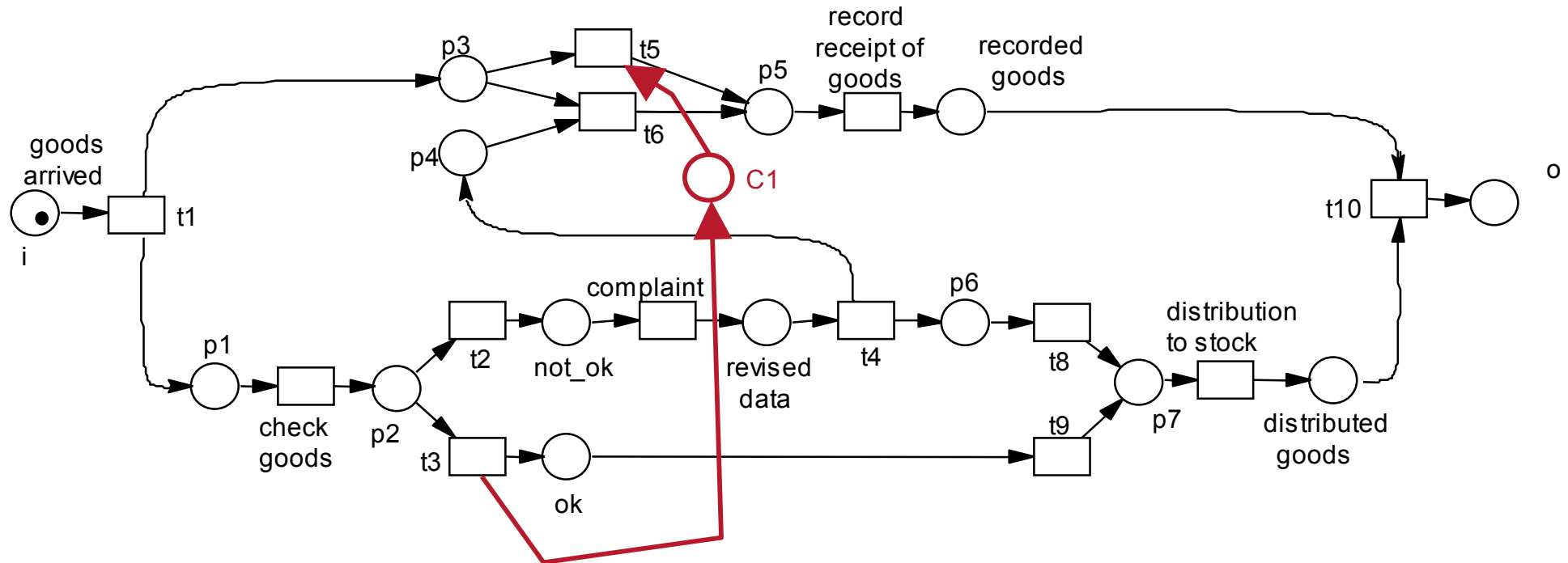


# Revised Model



Failure Feedback: relaxed sound, but not sound.

# Transformed Model (sound)



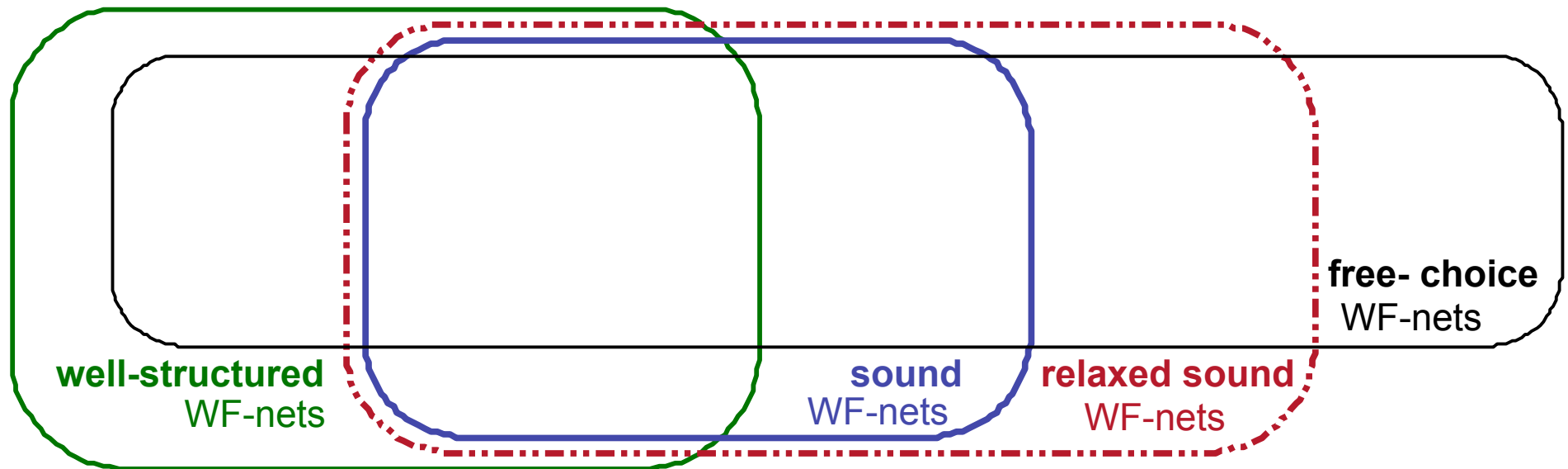
The efficiency of the applied algorithm was proved to be polynomial in the size of markings [GRX03].



# Relations Between the Properties

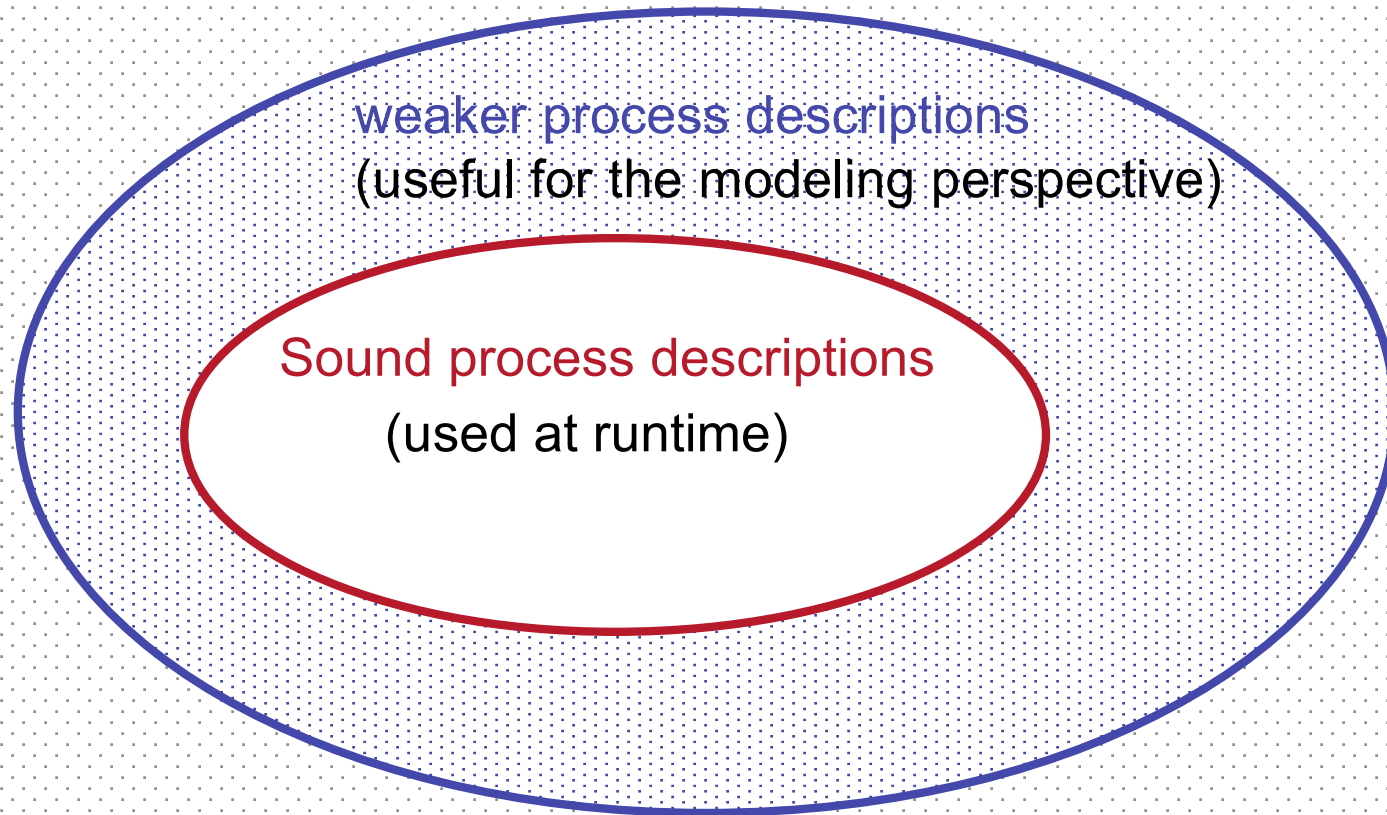
well-structuredness and relaxed soundness  
→ soundness

# Summary of Relations



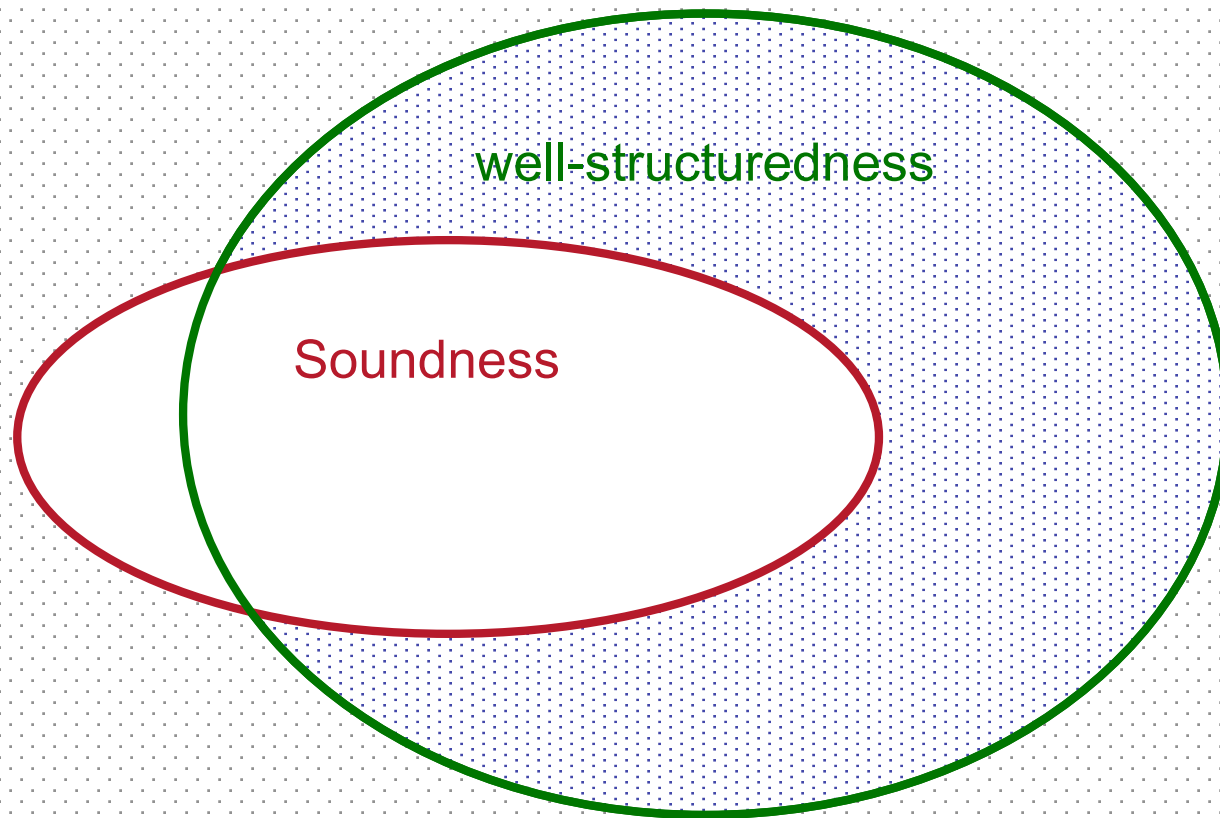
Euler-Diagram showing relations between different PN-properties

# Demands on a Weaker Criterion



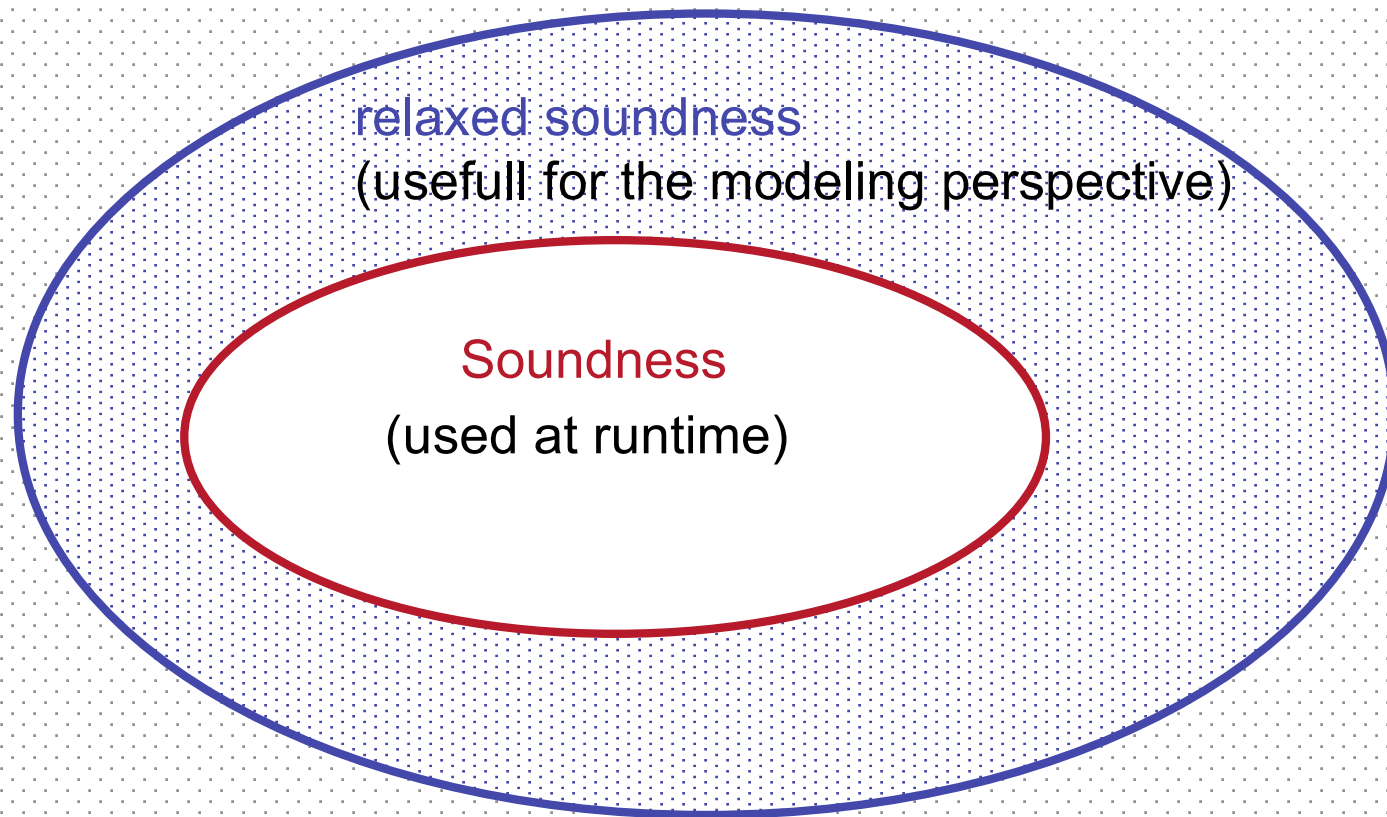
process descriptions  
containing serious failures

# Well-Structuredness ?



process descriptions  
containing serious failures

# Relaxed Soundness !



process descriptions  
containing serious failures

**Thank you for your attention.**

# References

- [Aal00] W.M.P. van der Aalst. Workow Verication: Finding Control-Flow Errors using Petri-net based Techniques. In Business Process Mangement: Models, techniques, and Empirical Studie, volume 1806 of LNCS, pages 161-183. Springer Verlag, 2000.
- [DeAa04] J. Dehnert and W.M.P. van der Aalst. Bridging the Gap Between Business Models and Workow Specications. *Int. Journal of Cooperative Information Systems (IJCIS)*, 13(3):289-332, 2004.
- [GRX03] A. Ghaari, N. Rezg, and X. Xie. Feedback control logic for forbidden-state problems of marked graphs: application to a real manufacturing system. *IEEE Transactions on Automatic Control*, 48(1):18-29, 2003.
- [HSV04] K. van Hee, N. Sidorova, and M. Voorhoeve. Generalised Soundness of Workow Nets is Decidable. In W. Reisig J. Cortadella, editor, *Int. Conf. on Application and Theory of Petri Nets*, volume 3099 of LNCS, pages 197-216. Springer, 2004.