Automated Annotations in Domain-Specific Models

Analysis of 23 Cases

Steven Kelly, Juha-Pekka Tolvanen

22.6.2021

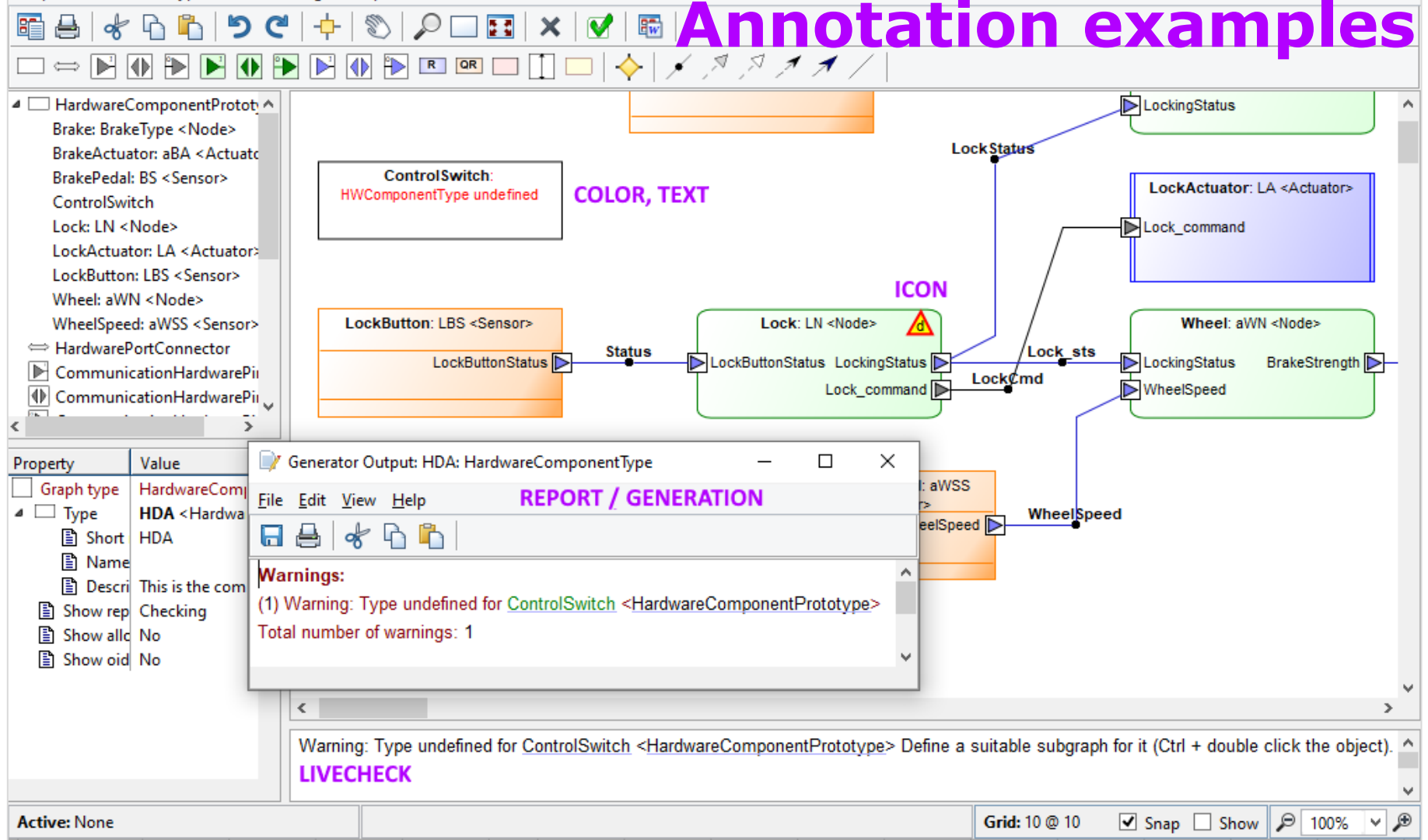
Where do annotations fit in?

- Abstract syntax
- Concrete syntax (Notation)
- **Automated annotations**
- Manual layout
- Manual annotations

Tool draws when model needs work

- ✓ Automated annotations are graphical models' equivalent of source code error highlighting and error/warning lists
- ✓ 90% of users want automated annotations in models
- ✓ Added value that the tool can offer – if not distracting

Annotation examples



Categories of Automated Annotations

Visual representation:

In Notation

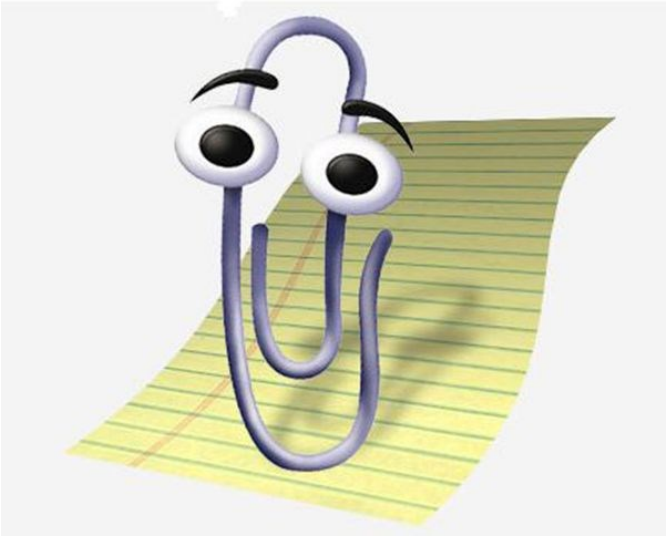
- Icon
- Color
- Text

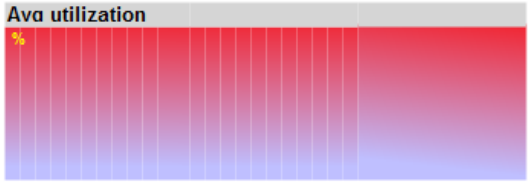
Separate Textual

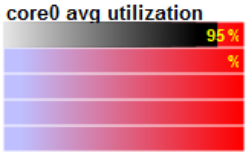
- LiveCheck
- Report
- Generation

Semantic content:

- Error
- Warning
- Guidance
- Results of analysis
- Animation

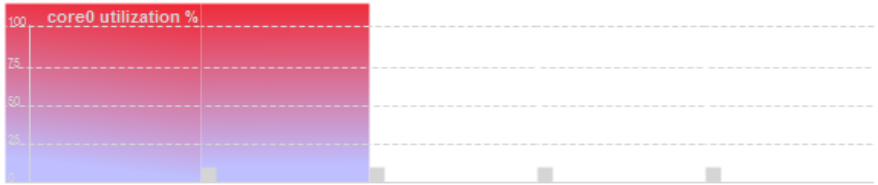


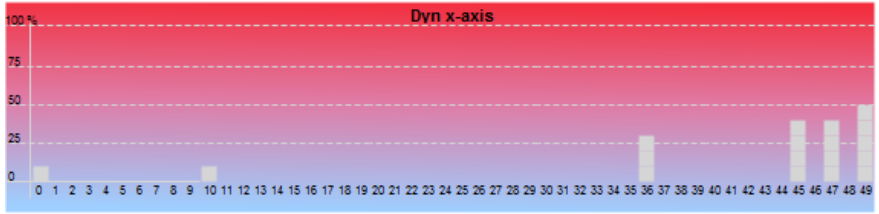




Graphical Animation of Run-time Values

cf. Digital twin





23 cases across a broad range

ID	Problem domain	Years*	Users
1	Home automation	0.1	1
2	Database applications	0.2	2
3	Data architecture	0.2	6
4	Insurance products	2	4
5	Insurance systems	4	**40**
6	Enterprise applications	**5**	**12**
7	Big data applications	1	4
8	Phone UI applications	**8**	**400**
9	Government EA	4	**16**
10	AI bot	0.3	2
11	Call processing	**19**	6

ID	Problem domain	Years	Users
12	Medical	2	2
13	Security	1	6
14	Industrial automation	4	2
15	Consumer electronics	**6**	1
16	Blockchain ecosystems	0.25	**34**
17	Software testing	3	**55**
18	Telecom	3	2
19	Performance testing	3	2
20	Aerospace	4	2
21	Consumer electronics	**12**	**24**
22	Automotive ECU	**5**	2
23	Automotive architecture	**11**	5

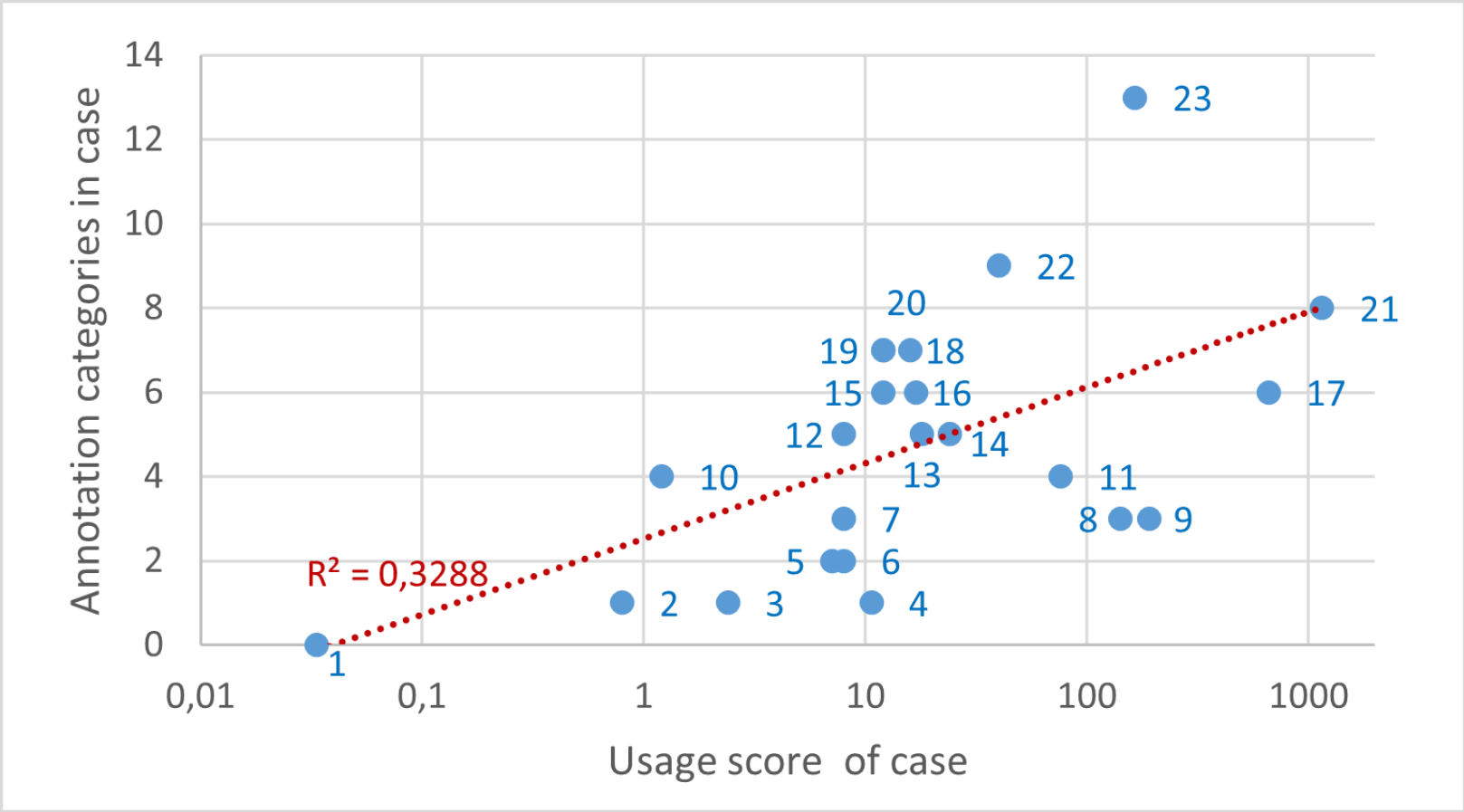
* Years of active language development

ID	Problem domain	Note	Years	Phase	Users	Icon	Color	Text	LiveCheck	Report	Generation
1	Home automation	*	0.1	1	1						
2	Database applications		0.2	2	2			G			
3	Data architecture		0.2	2	6					E	
4	Insurance products	*	2	4	4					W	
5	Insurance systems	* 3	4	4	40					R	R
6	Enterprise applications	3	5	4	12						E W
7	Big data applications		1	2	4				E W	E	
8	Phone UI applications	* 2	8	4	400					R	E R
9	Government EA		4	3	16		R			E W	
10	AI bot		0.3	2	2	W	A	W R			
11	Call processing	*	19	2	6				E W	E W	
12	Medical		2	2	2	R		R	E	E	E
13	Security		1	3	6		R	R	E G	E	
14	Industrial automation		4	3	2			G		E W	E W
15	Consumer electronics		6	2	1				E W	E W	E W
16	Blockchain ecosystems		0.25	2	34				E W G	E W G	
17	Software testing		3	4	55			E	E W	E W G	
18	Telecom		3	2	2	W	W	E W		E W	R
19	Performance testing		3	2	2	R A	E G	E G			E
20	Aerospace		4	2	2				E	E W R	E W R
21	Consumer electronics		12	4	24		E G	E W G		E W R	
22	Automotive ECU		5	4	2	E	E	E	G	E W	E W R
23	Automotive architecture	1	11	3	5	G	E W	E W G	W G	E W R	E W

Count of cases including each semantic and visualization category

	Error	Warning	Guidance	Results of analysis	Animation	Total
Icon	2	2	1	2	1	**8**
Color	5	1	3	2	1	**12**
Text	5	4	5	2	0	**16**
Graphical	*12*	*7*	*9*	*6*	*2*	***36***
LiveCheck	8	6	5	0		**19**
Report	14	11	1	4		**30**
Generation	8	6	0	4		**18**
Text Views	*30*	*23*	*6*	*8*		***67***
Total	**42**	**30**	**15**	**14**	**2**	**103**

Annotations increase with usage — particularly graphical annotations



Conclusions

- Textual common, but usage increases with graphical annotations
- Errors & warnings most common, animation rare

- Annotations directly in model give information in context
- Trade-offs: prevent error in language vs. allow and highlight, unobtrusiveness vs. detailed messages, coverage vs. performance
- Good tool support makes adding annotations fast & easy
  - Logic from generator reused in icons, LiveCheck, reports etc.

Thank you for listening!

What would you like to know now?

For more examples, case studies, analyst reports, articles:

metacase.com

dsmforum.org