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Topic 35 Domain Facets	• The aims are // * to introduce the concept that a proper domain description is made up from
• The prerequisite for following this (part of the) lecture is that you, as a	most of the following constituent descriptions:
 The prerequisite for honowing this (part of the) fecture is that you, as a domain engineer, need to know: which are the constituents of a proper model of a domain? 	 ◊ business processes, ◊ rules & regs., ◊ intrinsics, ◊ scripts,
	♦ supp.techns., ♦ human behaviour,
	\diamond mgt. & org., $\qquad \diamond$ etc.,
	and
	\star to present principles, techniques and tools for the description of these facets.
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\star to ensure that you will become a thoroughly professional domain	Introduction
engineer.	• The lecture constitutes a first high point of the present lecture series,
• The treatment is from systematic to formal.	• because in this lecture we present principles and techniques of software development
	• that are not otherwise available in any other textbook on software engineering.
	• So take your time to become thoroughly familiar with the contents of the present chapter.
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/	
Characterisation 11.174 By a <i>domain facet</i> we understand	• In this lecture we identify a number of <i>domain facets</i>
• one amongst a finite set of generic ways	 and we survey principles and techniques for modelling, relative to identified domain stakeholder classes, each of the identified facets.
• of analysing a domain:	• So far we have been able to identify the following facets:
• a view of the domain,	\star intrinsics,
• such that the different facets cover conceptually different views,	\star support technology,
• and such that these views together cover the domain	\star management and organisation,
	* rules and regulations including
•	* script facets, and * human behaviour.
	* numan benaviour.
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• We enlarge upon the above enumeration using the following brief	* Domain management and organisation:
characterisations:	That which primarily determines and constrains
* Domain intrinsics:	communication between enterprise stakeholders
That which is common to all facets	* Domain rules, regulations and scripts:
* Domain support technologies:	That which guides the work of enterprise stakeholders, their interaction, and the interaction with non-enterprise.
That in terms of which several other facets (intrinsics,	interaction, and the interaction with non-enterprise stakeholders
business processes, management and organisation, and rules	Statenolucis
and regulations) are implemented	

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www.init/ability.httlile April 5 2006, 09.36 Page 1021, Taple: 26, Fol 8 Description of the constraint of the constrai	Image depicted (f) (Aut)
	of which the intrinsics (and so on) are implemented
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edelyadi(3611/2611+ April 5.200, 09.56 Prog. 105. Topic. 35. Foil 11 Bland Present Park (0.200 Prog. Long 6. Separation of Concerns	Principle 11.51 Separation of Facets: When possible, one should identify distinguishable facets and, when appropriate, i.e., if feasible
We shall now treat each of these facets in some detail.For each we venture to express some specification pattern that most closely captures the essence of the facet.	 and pleasing, treat them separately. We believe that the facets we shall present can be treated separately in most developments — but not necessarily always.
• Separating the treatment of each of these (and possibly other) facets reflects the following principle:	 Separation or not is a matter of development as well as of presentation style.
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Discussion of the Separation Principle	* domain requirements,
• The separation, in more generality, of computing systems development into the triptych of	\star interface requirements and
\star domain engineering,	* machine requirements
* requirements engineering and	(within requirements engineering),• as well as the separation of
★ machine (hardware + software) design	• as well as the separation of * software architecture and
is also a result of separation of concerns.	* component and module design.
145 126 Far + 6 408 194 © Daw Space, Falley 11, D5 208 Mate, Owned Fault, & Bench, & Bench, & SpaceSpacelane, dawSpace bit, UK, non insta. B. A. 'A	-66 453 726 / Io- +66 681 EV1 () Dim Genery Frader, 11, 057 889 Hale, Oversa Enable della esta, de Spendiguel con, derediguer Sci (10, version de de l'
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Interview Age 1 & 366, 105 https://doi.org/10.1000/100001100.00000000000000000000	April 2 data that a free is the 2 statement of a statement of
• A domain is often known to its stakeholders by the various actions they play in that domain.	★ for a potential passenger to plan, buy tickets for, and undergo a journey.
• That is, the domain is known by the various sequences of entities, functions and events the stakeholders are exposed to, are performing and are influenced by.	* For the driver of the locomotive the sequence of undergoing a briefing of the train journey plan, taking possession of the train, checking some basic properties of that train, negotiating its start, driving it down the line, obeying signals and the plan, and,
• Such sequences are what we shall here understand as business processes.	finally entering the next station, stopping at a platform, and concluding a trip of the train journey — all that constitutes a business process.
	\star For a train dispatcher, the monitoring and control of trains and signals during a work shift constitutes a business process.

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• Describing domain intrinsics focuses on the very essentials of a / domain.	Principle 11.52 Describing Domain Business Process Facets:
It can sometimes be a bit hard for a domain engineer, in	• As part of understanding any (at least human-made) domain it is important to delineate and describe its business processes.
llaboration with stakeholders, to decide which are the domain trinsics.	• Initially that should preferably be done in the form of rough sketches.
It can often help (the process of identifying the domain intrinsics) if one alternatively, or hand in hand analyses and describes what is known as the business processes.	• These rough sketches should — again initially — focus on identifiable entities, functions, events and behaviours.
om a description of business processes one can then analyse	 Naturally, being business processes, identification of behaviours comes first.
h parts of such a description designate, i.e., are about or relate which facets.	• Then be prepared to rework these descriptions as other facets are being described in depth
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Business Processes	Example 11.126 Some Business Processes:
	• A Business Plan Business Process:
haracterisation 11.175 By a business process we understand	* The board of any company instructs its chief executive officer (CEO) to
the procedurally describable aspects, of one or more of the ways in	formulate revised business plans. ¹³
which a business, an enterprise, a factory, etc.,	★ Briefly, a business plan is a plan for how the company strategically, tactically and, to some extent, operationally wishes to conduct its business: what it
conducts its yearly, quarterly, monthly, weekly and daily processes, that is, regularly occurring chores.	strives for, productwise, imagewise, market-share-wise, financially, etc.
\star The processes may include strategic, tactical and operational management	★ The CEO develops a business plan in consultation with executive layers of (i.e., with strategic) management.
and workflow planning and decision activities; and	\star Strategic management (in-between) discusses the plan (which the CEO
* the administrative, and where applicable, the marketing, the research and	wishes to submit to the Board) with tactical management, etc.
development, the production planning and execution, the sales and the service (workflow) activities — to name some	\star Once generally agreed upon, the CEO submits the plan to the Board.
• • •	
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A Purchase Regulation Business Process:	\star The person who issued the $purchase$ inquiry request may now proceed to issue
\star In our "example company", purchase of equipment must adhere to the	a purchase request order, attach the purchase inquiry report and
following — roughly sketched — process:	\star send this to the relevant budget controlling manager for acceptance. \star If purchase is approved then the purchasing department is instructed to issue
Once the need for acquisition of one or more units of a certain equipment, or a related set of equipment, has been identified,	to the chosen supplier, a purchase request order .
\star the staff most relevant to take responsibility for the use of this equipment	* Once the supplier delivers the ordered equipment, the purchasing department
issues a purchase inquiry request.	inspects the delivery and issues an equipment inspection report . * An invoice from the supplier for the above-mentioned equipment is only paid
 The purchase inquiry request is sent to the purchasing department. The purchasing department investigates the market and reports back with a 	* An involce from the supplier for the above-mentioned equipment is only paid if the equipment inspection report recommends to do so.
purchase inquiry report containing facts about possible equipment choices,	\star Otherwise the delivered equipment is returned to the supplier.
prices, and their purchase (i.e., payment), delivery, service and guarantee conditions.	 The above is but a rough sketch. Much more precision is needed, as are descriptions of exceptions, etc.
	The second s
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terren al angel a series and a	1.1.1 Bunisme Processes Supported of Language
ample 11.127 Some More Business Processes:	• Renovation: "Review the campus' remodelling and alterations
Iuman Resources: "Examine the hiring business process of the	business process, and develop recommendations to improve
Jniversity, including the applicant process. Special emphasis	Facilities Management services to other departments for small
hould be given to simplifying the process, identifying those parts	projects (under \$50,000) and minor capital projects (up to
where there is no value added — i.e., where those parts of the	\$250,000). Special emphasis should be given to simplifying the
process which one considers <i>simplifying "away</i> " add no value.	process, identifying those parts where there is no value added to the customer's product; to increase speed and flexibility of
Increase speed of response to applicant and units and reduce	the customer's product, to increase speed and nexionity of

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Example 11.1	126 Some Busi	iness Processes:		,
• A Business Pla	n Business Process	3:		
	f any company ins vised business plar	structs its chief execut ns. ¹³	tive officer (CEO) to	
and, to some	e extent, operation	*	ny strategically, tactically t its business: what it ise, financially, etc.	
	evelops a business rategic) manageme	*	with executive layers of	
0	· · ·	veen) discusses the pl) with tactical manag	· · · · · · · · · · · · · · · · · · ·	
∗ Once genera	llv agreed upon. th	he CEO submits the	plan to the Board.	
625 3720, Fau: +45 4593 0074	(j) Dines Rjømer, Fendorej 11, DK-	-340 Hitte, Dennak	Emaile: &Bonndts &, sjonnebynail.com, denobijenne kiz 1981. v	un inn da i
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: "Review the campus' remodelling and alterations ess, and develop recommendations to improve nagement services to other departments for small er \$50,000) and minor capital projects (up to becial emphasis should be given to simplifying the tifying those parts where there is no value added to 's product; to increase speed and flexibility of response; and to reduce process costs while achieving high quality."

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process and develop recommendations/solutions for process improvement. The redesigned process should provide "hassle-free" purchasing, give a quick response time to the purchaser, be economical in terms of all costs, be reasonably error-free and be compliant with (US) Federal procurement standards."	/	stage when a faculty/staff member identifies the need to travel to the time when reimbursement is received. Analyze and redesign the process through a six step program based on the following business process improvement (BPI) principles: (i) simplify the process, (ii) identify those parts where there is no value added to the customer, increase (iii) speed and (iv) flexibility of response, (v) improve clarity for responsibilities and (vi) reduce process costs while meeting customer expectations from travel services. The redesign should reflect customer needs, service, economy of operation and be in compliance with applicable regulations."	
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www.wellightlickliki Add 5. 2006,00.35 Page 1801, Taple: 85, Fail: 13 Wind Home Annual Restance Annu	—/	 Parking: "Review how parking permits are sold to customers and staff with the intent of omitting unnecessary steps and redundant data collection. The redesigned process should achieve a dramatic reduction in time spent by people standing in line to purchase a permit, and reduce administrative time (and cost) in recording and tracking permit sales." Please observe that the above examples illustrate requests for possible business process reengineering — but that they also give rough-sketch glimpses of underlying business processes. 	/
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understand • the identification of which business processes should be subject to		• Business plans:	
precise description,describing these and securing their general adoption (acceptance)		★ We assume, about our example company, that — up to a certain time — there was no set procedure wrt. the creation, etc., of business plans.	
in the business, and • enacting these business process descriptions		★ As the company grows, a need is felt for "stricter" procedures wrt. business plans.	
	•	\star Therefore the CEO and/or the board drafts the business plan very implicitly hinted at in Example 11.126 first bullet.	
		\star The last two sentences, above, portray an example business process engineering.	
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★ We assume, about our example company, that — up to a certain time — there was no set procedure wrt. purchase of equipment.		We summarise:	
\star As the company grows, a need is felt for "stricter" procedures		 Principles 11.53 • Human-made universes of discourse • entail the concept of business processes. 	
 wrt. procurement. * Therefore some (say, operations) manager drafts the purchase process roughly sketched in Example 11.126 second bullet (Foils 1035–1036). 	3	 entail the concept of business processes. The principle of business processes states that the description of business processes is indispensable in any description of a human-made universe of discourse. 	
\star The previous two sentences portray an example business process engineering.	s	• The principle of <i>business processes</i> also states that describing these is not sufficient: all facets must be described	
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• identification and description of a suitably compret			• RSL/CSP definition of processes,			
behaviours: the behaviours of interest and the env			\star where one suitably defines the	er <i>in</i> put/ <i>out</i> put signatu	res,	
• identification and description, for each behaviour, o	,		\star associated $channel$ names and	l types,		
characteristic of this behaviour;	or the entitles		\star and their process definition be	odies;		
			• Petri nets;			
• identification and description, for each entity, of the apply to entities, or from which entities are yielded			 message and live sequence charts behaviours; 	for the definition of inte	eraction between	
\bullet identification and description, for each behaviour, c			\bullet state charts for the definition of h	ighly complex, typically	interwoven behaviours	з;
that it shares — either with other specifically ident of interest, or with a further, abstract, environment			 and the usual, full complement of constructs and their abstract teel 			
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Informal and Formal Examples	s	/	 Hence we shall emphasise, i process diagrams. 	n these examples, th	e behaviour, or	
• We rough-sketch a number of examples.			• We leave it to other example	les to present other a	aspects, so that	
• In each example we start, according to the principle techniques enunciated above, with	les and		their totality yields the prin domain description.	ciples, the technique	es and the tools of	
\star identifying behaviours, events, and hence			and a second provide the second			
* channels and the						
★ type of entities communicated over channels, i.e. events.	. participating in	1				
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- \diamond get permission from ground control towers to depart;
- ♦ proceed to fly according to a flight plan (an entity);
- ◊ keep in contact with area control centres along the route,
 ◊ (upon approach) contacting terminal control towers from
- which they, simplifying, get permission to land; and
- \diamond upon touch down, changing over from terminal control tower to ground control tower guidance.

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aircraft to area control centres.

etc. (as another business process).

♦ and, on the other hand, hand over monitoring and control of departing

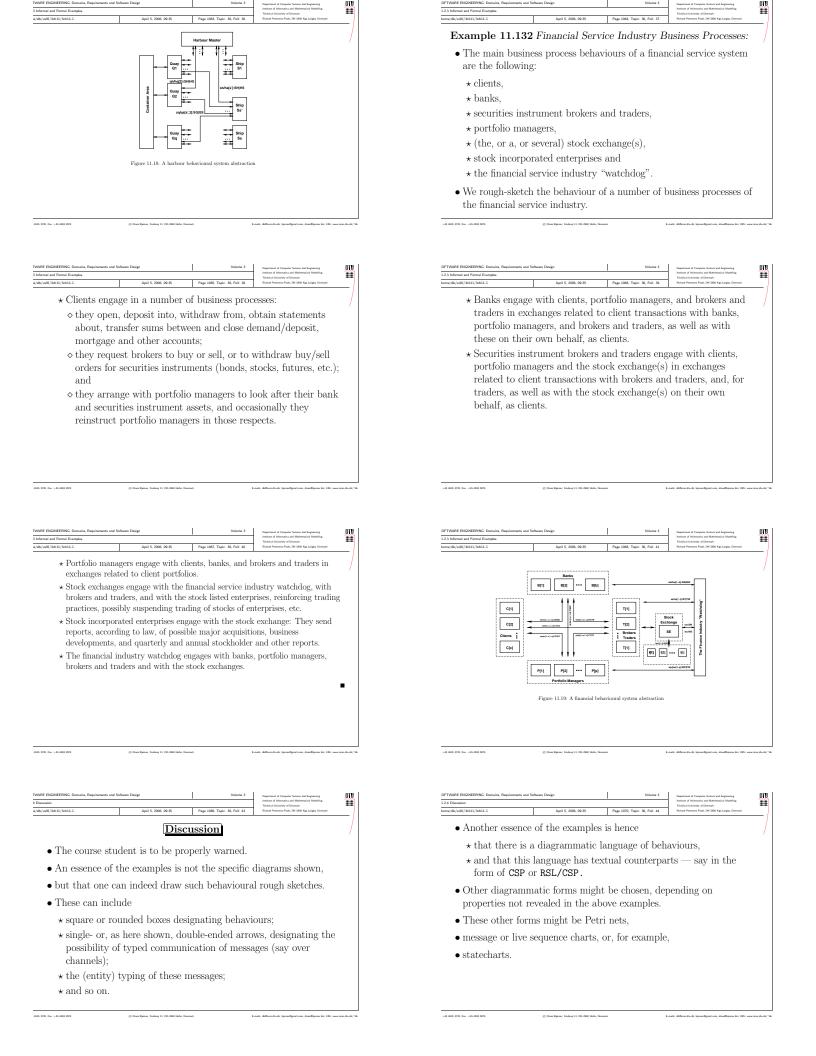
 \diamond Ground control towers, on behalf of a requesting aircraft, negotiate with

certain "slot" rules and regulations (as one business process).

destination ground control tower and (simplifying) with continental control centres when a departing aircraft can actually start in order to satisfy

♦ Ground control towers, on behalf of the associated airport, assign gates to landing aircraft, and guide them from the spot of touchdown to that gate,

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<text></text>	\star The terminal control towers	\star The area control centres handle aircraft flying over their territory:
<form></form>	♦ play their major role in handling aircraft approaching airports	\diamond taking over their monitoring and control
 a. http://www.net.a	with intention to land.	
	\diamond They may direct these to temporarily wait in a holding area.	
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	♦ and pass their monitoring and control on to the ground control	
		\circ or to neighbouring area control centres (as yet another business process).
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 * the transport companies on whose conveyors freight is being transported, * the hubbs between which freight conveyors "ply their trade", * the onceivers of freight * (Fig. 11.7). * A detailed description for each of the freight logistics business process behaviours listed above should now follow. * We have this as an exercise to the reader to complete. The main business process behaviours of a harbour system are the following: * the harbourmaster who allocates and schedules ships to quays, * the harbourmaster who allocates and schedules ships to quays, * the container area which temporarily stores ("houses") containers 		
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 A detailed description for each of the freight logistics business process behaviours listed above should now follow. We leave this as an exercise to the reader to complete. 	\star the receivers of freight	Heng Hubs Conveyours
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 The main business process behaviours of a harbour system are the following: the ships who seek harbour to unload and load cargo at a harbour quay, the harbourmaster who allocates and schedules ships to quays, the quays at which ships berth and unload and load cargo (to and from a container area) and the container area which temporarily stores ("houses") containers A detailed description for each of the harbour business process behaviours listed above should now follow. We leave this as an exercise to the reader to complete 	Example 11.131 Harbour Business Processes	• There may be other parts of a harbour:
 The final obsides process behaviours of a harbour system are the following: the ships who seek harbour to unload and load cargo at a harbour quay, the harbour quay, the harbourmaster who allocates and schedules ships to quays, the quays at which ships berth and unload and load cargo (to and from a container area) and the container area which temporarily stores ("houses") containers the container area which temporarily stores ("houses") containers 		
 at a buoy or a quay, at a buoy or a quay, at a buoy or a quay, or for ships to rest before proceeding; as well as buoys at which ships berth and unload and load cargo (to and from a container area) and the container area which temporarily stores ("houses") containers 	1 0	
 * the ships who seek harbour to unload and load cargo at a harbour quay, * the harbourmaster who allocates and schedules ships to quays, * the quays at which ships berth and unload and load cargo (to and from a container area) and * the container area which temporarily stores ("houses") containers • A detailed description for each of the harbour business process behaviours listed above should now follow. • We leave this as an exercise to the reader to complete 	tollowing:	
 harbour quay, * the harbourmaster who allocates and schedules ships to quays, * the quays at which ships berth and unload and load cargo (to and from a container area) and * the container area which temporarily stores ("houses") containers * the container area which temporarily stores ("houses") * the container area which temporarily stores ("houses") * We leave this as an exercise to the reader to complete 	\star the ships who seek harbour to unload and load cargo at a	
 * the harbourmaster who allocates and schedules ships to quays, * the quays at which ships berth and unload and load cargo (to and from a container area) and * the container area which temporarily stores ("houses") containers • We shall assume that the course student can properly complete an appropriate, realistic harbour domain. • A detailed description for each of the harbour business process behaviours listed above should now follow. • We leave this as an exercise to the reader to complete. 	· · · · · · · · · · · · · · · · · · ·	
 * the quays at which ships berth and unload and load cargo (to and from a container area) and * the container area which temporarily stores ("houses") containers • We shall assume that the course student can properly complete an appropriate, realistic harbour domain. • A detailed description for each of the harbour business process behaviours listed above should now follow. • We leave this as an exercise to the reader to complete. 	- • ·	
and from a container area) and * the container area which temporarily stores ("houses") containers * We leave this as an exercise to the reader to complete		
 A detailed description for each of the harbour business process behaviours listed above should now follow. We leave this as an exercise to the reader to complete. 		
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• We leave this as an evercise to the reader to complete	- • • • •	
• (Fig. 11.18).	containers	
	• (Fig. 11.18).	• We leave this as an exercise to the reader to complete.
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• Furthermore, the examples	\bullet The course student should understand that to describe domains
\star are sketchy,	fully satisfactorily requires
\star but they provide an immediate, constructive start	\star at least the full complement of principles, techniques and tools
\star to the arduous task of carefully and pains takingly describing a domain.	\star covered in all chapters of Vols. 1 and 2, \star as well as in all the chapters up to and including all of the
• In all examples we have sketched the suggested arrays of channels and their types (as sorts).	present chapter in this volume!
\star These are just suggestions.	
\star Interactions between behaviours are then modelled in terms of	
messages communicated over these channels.	
* But such models are just that: there is no obligation on the part	
of any, subsequent software design to implement channels as something anywhere similar to channels!	
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Summary	Reminder
The purpose of first rough-sketching a number, not necessarily all,	We remind the reader of the principle stated at the outset of this
identifiable business processes is to use these descriptions to identify	lecture on domain business process facets.
• entities, • events and	
• functions, • behaviours,	
as well as to classify these into their "facethood":	
• intrinsics, • rules and regulations,	
• support technologies, • scripts and	
• management and organisation, • human behaviour.	
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Principle 11.54 Describing Domain Business Process Facets:	• A main reason for initially describing the business processes of a
• As part of understanding any (at least human-made) domain it is	domain
important to delineate and describe its business processes.	\star is to discover, identify and capture entities, functions, events and behaviours of that domain.
• Initially that should preferably be done in the form of rough sketches.	
	• Another good reason
• These rough sketches should — again initially — focus on identifiable entities, functions, events and behaviours.	\star is to get the process of description started — somewhere!
• Naturally, being business processes, identification of behaviours	
a a marter a firmate	
comes first.	
• Then be prepared to rework these descriptions as other facets are	
• Then be prepared to rework these descriptions as other facets are	
 Then be prepared to rework these descriptions as other facets are being described in depth . 	14 653 525 Far - Hi dill 1874 © Dine Tgener, Fasheri, L. Dir Stell Halt, Starvat. E such: definer-du di, Speerdynal con, denthyseer bij, 168, was in di
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• Then be prepared to rework these descriptions as other facets are being described in depth • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • •	OFTNARE ENGINEERING. Dumains, Requirements and Software Design Volume 3 Department of Compare Knows and Explorating
Then be prepared to rework these descriptions as other facets are being described in depth The second se	OFTNARE ENGINEERING. Dumains, Requirements and Software Design Volume 3 Department of Compare Knows and Explorating
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• Then be prepared to rework these descriptions as other facets are being described in depth	OFTWORE ENCIREERING: Dunnine, Repriments and Schware Dedge Volume 3 1.3 Domain International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International International I
• Then be prepared to rework these descriptions as other facets are being described in depth	OFTIMME ENCINEENDS: Durwiss, Represents and Software Design Volume 3 13 Danada Institution Institution mm(dk)(wl1/kh1/kh1i) April 5,2006,00.35 Page 10706, Tapic 37, Tapic 32 Principles 11.55 Domain Intrinsics: From the outset of describing
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• Different stakeholder perspectives,	Example 11.134 Comparable Intrinsics: We refer to Example 11.133. We claim
• not only of intrinsics, as here,	that the concept of nets, lines and stations in the three models of Example 11.133 must relate. The simplest possible relationships are to let the third model be the
• but of any facet,	common "unifier" and to mandate
• leads to a number of different models.	• that the model of nets, lines and stations of the <i>potential train passengers</i>
• The name of a phenomenon of one perspective, that is, of one model,	formalisation is that of nets, lines and stations of the train operating staff
• may coincide with the name of a "similar" phenomenon of another perspective,	model; and
that is, of another model, and so on.	• that the model of nets, lines, stations and tracks of the <i>actual train passengers</i>
• If the intention is that the "same" names cover comparable phenomena, then the	formalisation is that of nets, lines, stations of the <i>train operating staff</i> model.
developer must state the comparison relation.	Thus the third model is seen as the definitive model for the stakeholder views initially expressed.
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• In general the relationships to be expressed between different stakeholder models	• In the above description such things as lines, stations and units, including their
require more elaborate expressions.	particular kind (linear, switch, etc.) are phenomena, that is, they can be pointed
• To express these formally, in RSL , we make use of RSL 's <i>scheme</i> facility.	to.
* More elaborate stakeholder schemes can be expressed by extending basic	 Such things as connectors and paths could be considered either phenomena or concepts.
(i.e., intrinsic) schemes with additional types, values and axioms.	• Unit states and unit state spaces, including the idea of open and closed units,
★ The hiding facility of schemes can likewise be used to express different, but commensurate models.	• Our states and time state spaces, including the idea of open and closed times, will here be considered concepts.
	• The above example is only indicative.
	• Much care must be taken to ensure that a description is consistent and complete.
	• Care must also be taken to not describe phenomena or concepts that more
	properly belong to some other facets, as covered next.
	• Identifying and describing intrinsics is also an art!
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Ownell Principles Operating & Company, Section 2014, Section	1.3.1 Overall Principles International Model of the State
c _ c _ c _ c _	Example 11.135 Intrinsics of Switches:
	• The intrinsic attribute of a rail switch is that it can take on a number of states.
	 A simple switch ([°]Y_c^c) has three connectors: {c, c₁, c_/}. c is the connector of the common rail from which one can either "go straight" c₁, or "fork" c_/.
	• So we have that a possible state space of such a switch could be ω_{q_e} :
	• So we have that a possible state space of such a switch could be ω_{g_s} .
	{{},
Figure 11.20: Possible states of a rail switch	$\{(c,c)\}, \{(c_1,c)\}, \{(c,c_1), (c_1,c)\}, \{(c,c_2), (c_1,c_2)\}, \{(c,c_2), (c_2,c_3)\}, \{(c,c_3), (c_3), (c_3$
	$ \{ (c, c_{i}) \}, \{ (c_{i}, c) \}, \{ (c, c_{i}), (c_{i}, c) \} \} $
	$\{(c, c_{ }), (c_{ }, c), (c_{/}, c)\}, \{(c, c_{/}), (c_{/}, c), (c_{ }, c)\}, \{(c_{/}, c), (c, c_{ })\}, \{(c, c_{/}), (c_{ }, c)\}\}$
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• The above models a general switch ideally.	Conceptual Versus Actual Intrinsics
• Any particular switch ω_{p_s} may have $\omega_{p_s} \subset \omega_{g_s}$.	
	\bullet In order to bring an otherwise seemingly complicated domain
• Nothing is said about how a state is determined:	across to the reader,
\star who sets and resets it,	• one may decide to present it piecemeal:
\star whether determined solely by the physical position of the switch	* First, one presents the very basics, the fewest number of
gear,	inescapable entities, functions and behaviours.
\star or also by visible or virtual (i.e., invisible, intangible) signals up	* Then, in a step of enrichment, one adds a few more (intrinsic)
or down the rail, away from the switch.	* Then, in a step of enrichment, one adds a few more (intrinsic) entities, functions and behaviours.
•	\star And so forth.
	* And so forth. * In a final step one adds the last (intrinsic) entities, functions and
	* In a final step one adds the last (intrinsic) entities, functions and behaviours.
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• In order to develop what initially may seem to be a complicated / domain,	Example 11.136 Conceptual Intrinsics: Freight Transport:
	• The very essence of freight transport is:
• one may decide to develop it piecemeal:	\star Entities: Senders, freight, "the system of transport", and
\star We basically do as for the presentation steps:	receivers.
* Steps of enrichments —	* Functions:
★ from a big lie, via increasingly smaller lies, till one reaches a truth!	 ♦ submitting an item of freight for transport, and ♦ receiving an item of freight having been transported.
	* Behaviour: Being transported.
	A Denaviour. Denig stansported.
455 E20, Far. + 64 683 E50 © Done Sgaraw, Fashing 11, Dir Sal O Halto, Donask Frank delfonsekusk, Sponelguratura, AsterByrow 12, UK, warian dar. Af / di	- e6 65 202 For + 66 68 824 () Done Typen, Fedraj 11, DK 360 Hzhr, Banada () Done Typen, Fedraj 11, DK 360 Hzhr, Banada () Done Typen () Done
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type	Example 11.137 Actual Intrinsics: Freight Logistics:
Sndr, Frei, Rcvr	• We now elaborate on "the system of transport" alluded to in
value	Example 11.136.
submit: Sndr \times Frei \rightarrow System \rightarrow System receiv: Rcvr \rightarrow System \rightarrow System \times Frei	* The system entities are: harbours, bills of lading, ships and ship
receiv: RCvr \rightarrow System \rightarrow System \times Frei transport: System \rightarrow System	routes (from harbours to harbours).
	\diamond We assume that there is no need to detail what are harbours,
Observe that we have said nothing, really, about "the system of	ships and ship routes.
transport.	♦ A bill of lading is a document, say attached to a piece of freight, which stipulates properties of the freight (sender,
	receiver, origin of transport, destination of transport and route
	of transport: sequence of harbours and ships, sailing times,
	etc.).
	- 46 465 120, Fac. + 6 483 804 © Dien Rjane, Federaj II, DK 366 Mite, Denak E-suite differendus de, kjenerdysal son, dendkjører bit UK: vere inn das diffe
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\star The system functions are:	\star A system behaviour could be the sequence of one submission,
\diamond submit a piece of freight to a harbour (of origin) indicating a	one or more pairs of loadings and unloadings, ended by one fetch.
receiver and a harbour of destination, and obtaining a bill of	♦ The above behaviour has abstracted "away" any notion of
lading; ◊ load a piece of freight from a harbour to a ship, as prescribed	sailings, ♦ i.e., of actual movement!
by that freight's bill of lading;	vice, or accuar movement.
♦ unload a piece of freight from a ship to a harbour, as	
prescribed by that freight's bill of lading;	
♦ fetching, by a receiver, a piece of freight from a destination	
harbour, as prescribed by that freight's bill of lading.	
455 22), Fac. + 6 688 8014 © Done Egener, Fredury 11, DK-386 Michz, Dones 4 Ernals: & define date 4, Sprontfacetion, Smothpure Sci UR, some inn date 4/26	+66 65 123; Fac: +6 663 529 () Ernel Report, Frederij II, DK 2069; Hans, Dennek Ernaliz, defensetur, de, jametganal can, denethjamet biz (UK), was inste dur, de/de
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type // Sndr. Na, Frei, Revr. Revr. Na,	The formalisation, as does the narrative, only rough-sketches some / intrinsics of freight logistics.
Harb, H.Na, Ship, S.Na, System, BoL Dest = H.Na	
value	\bullet We leave the two versions, the virtual and the "more realistic",
obs.Harbs: System \rightarrow Harb-set obs.HNa: Harb \rightarrow H.Na	further undefined.
obs_Route : BoL \rightarrow (H_Na \times S_Na)*	• Both descriptions were kept in the form of rough sketches.
obs_Dest : BoL \rightarrow HNa obs_RcvrNa : BoL \rightarrow Rcvr_Na	• The latter can take being further refined, i.e., made more precise.
obs_RevrNa : Revr \rightarrow Revr_Na	
submit: Sndr \times Frei \times Dest \rightarrow System \rightarrow BoL	
load: Frei × BoL × Ship × Harb \rightarrow Ship × Harb unload: BoL × Ship × Harb \rightarrow Ship × Harb × Frei	
receiv: $\operatorname{Revr} \to \operatorname{Harb} \to \operatorname{System} \to \operatorname{Frei} \times \operatorname{BoL}$ transp: $\operatorname{System} \to \operatorname{System}$	
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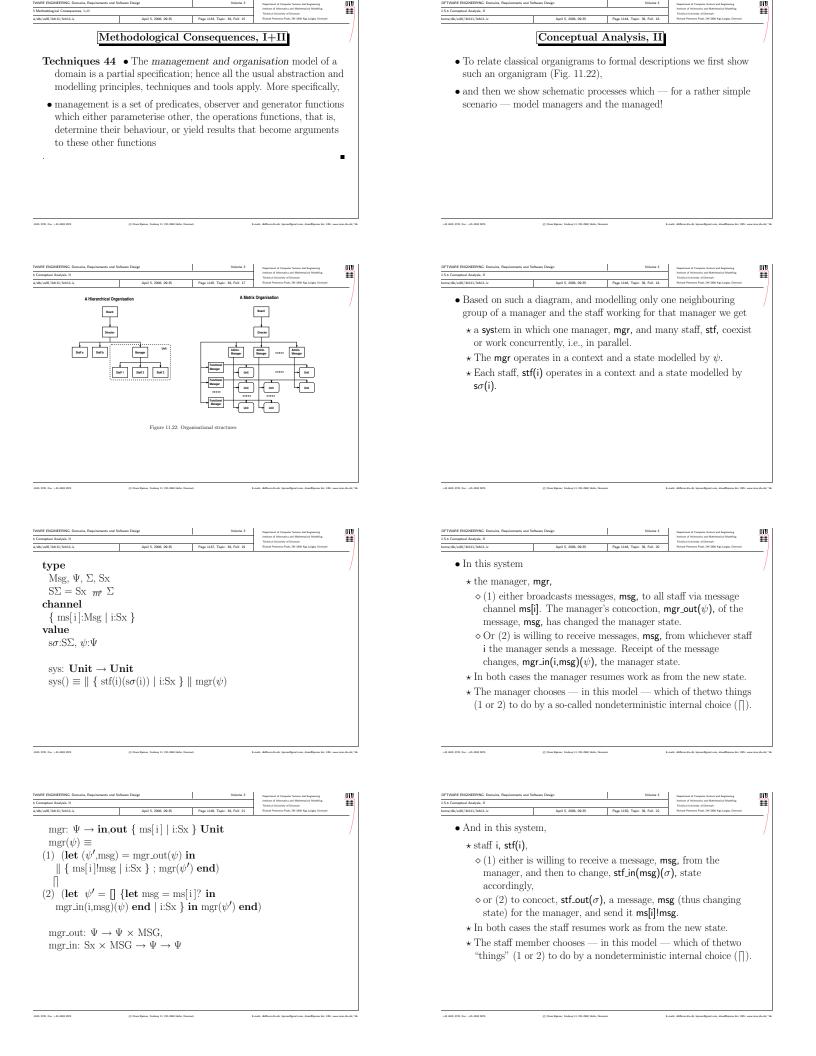
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Methodological Consequences	Discussion
Principles 11.57 In any modelling one first forms and describes	• Thus the intrinsics become part of every one of the next facets.
intrinsic facets.	• From an algebraic semantics point of view these latter are
Techniques 42 • The <i>intrinsics</i> model of a domain is a partial	extensions of the above.
specification.	• We have presented a story of intrinsics as truthfully as we could.
• As such, it involves the use of well-nigh all description principles.	\star To decide on what is intrinsics and what is not is an art — it is a
• Typically we resort to property-oriented models, i.e., sorts and	matter of choice, hence of style.
axioms	\star There is no clear-cut criterion according to which a line of
•	separation between intrinsics and nonintrinsics can be drawn.
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Utter Barebones Intrinsics	• The reason we bring this concept of <i>utter barebones intrinsics</i> up is three-fold.
• It was implied above that an absolute barebones intrinsics of	 First, the domain engineer must "think very hard" in trying to isolate, identify and capture the, or an utter barebones intrinsics of a domain.
railways was the atomic trains and the rail net abstracted to	\star Secondly, the "more frugal" the domain engineer has been in selecting the utter barebones
atomic lines and atomic stations.	entities, functions, events and behaviours, the more time that domain engineer has to care about properly extending that utter barebones intrinsics with the remaining domain facets
• Similarly one could claim that an absolute barebones intrinsics of a	covered next. \star Thirdly, by "forcibly" trying to isolate an utter barebone intrinsics the domain engineer is
hospital system was the atomic patients, atomic medical staff and	actually trying to establish a scientific basis for the domain. The domain describer is more of
atomic beds. Without the beds the first two kinds of entities would pass only for a physician's office.	a researcher than an engineer. This is basically untrodden land: few have tried to formulate domain descriptions let alone intrinsics, and very few, if any may have attempted to identify
 And similarly one could claim that an absolute barebones intrinsics 	the utter barebones of a domain.
for air traffic would be the aircraft, the airports and the air space.	 We claim that it is a prerequisite for good domain descriptions to have tried to discover utter barebones intrinsics.
• And so on.	
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Reminder	Topic 38
We remind the reader of the principle stated at the outset of this	Domain Support Technologies
ecture on domain intrinsics:	• Technology is meant to support human activities.
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Apri 5.2006, 09.35 Page 1111, Taple: 38, Fail 4 Read Planues That, Child Planues	hum;de/vull/3411/3411/3411/3 Example 11.138 Railway Support Technology: We give a rough
The above characterisation is denoerately loose.It is so, so that we are not, later, constrained by a too tight	sketch description of possible rail unit switch technologies.
characterisation.	 In "ye olde" days, rail switches were "thrown" by manual labour, i.e., by railway staff assigned to and positioned at switches.
• Therefore it is important to illustrate the idea,	• With the advent of reasonably reliable mechanics, pulleys and levers ¹⁴ (and steel wires), switches
\bullet so as to aid the student's intuition,	were made to change state by means of "throwing" levers in a cabin tower located centrally at the station (with the lever then connected through wires etc., to the actual switch).
• and thus enable proper identification and description of support	• This partial mechanical technology then emerged into electromechanics, and cabin tower staff
technologies.	was "reduced" to pushing buttons.Today, groups of switches, either from a station arrival point to a station track, or from a station
	track to a station departure point, are set and reset by means also of electronics, by what is known as interlocking (for example, so that two different routes cannot be open in a station if they cross one another).
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 It must be stressed that Example 11.138 is just a rough sketch. In a proper narrative description the software (cum domain) 	Example 11.139 <i>Probabilistic Rail Switch Unit State Transitions:</i>
engineer must describe, in detail, the subsystem of electronics, electromechanics and the human operator interface (buttons, lights,	• Figure 11.21 intends to model the probabilistic (erroneous and correct) behaviour of a switch when subjected to settings (to mitched (a) tota) and most impact (d) tota).
An aspect of supporting technology includes recording the	switched (s) state) and resettings (to direct (d) state).A switch may go to the switched state from the direct state when
state-behaviour in response to external stimuli.	• A switch may go to the switched state nom the direct state when subjected to a switch setting s with probability psd .
• We give an example.	
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ranipar diff-pode-bodd	Another example shows another aspect of support technology: • Namely that the technology must guarantee cartain of its sum behaviours
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wit-psd-exd wit-psd-exd wited alpos	Namely that the technology must guarantee certain of its own behaviours,so that software designed to interface with this technology,
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evel - pass-es- Lipse Exercise	Namely that the technology must guarantee certain of its own behaviours,so that software designed to interface with this technology,
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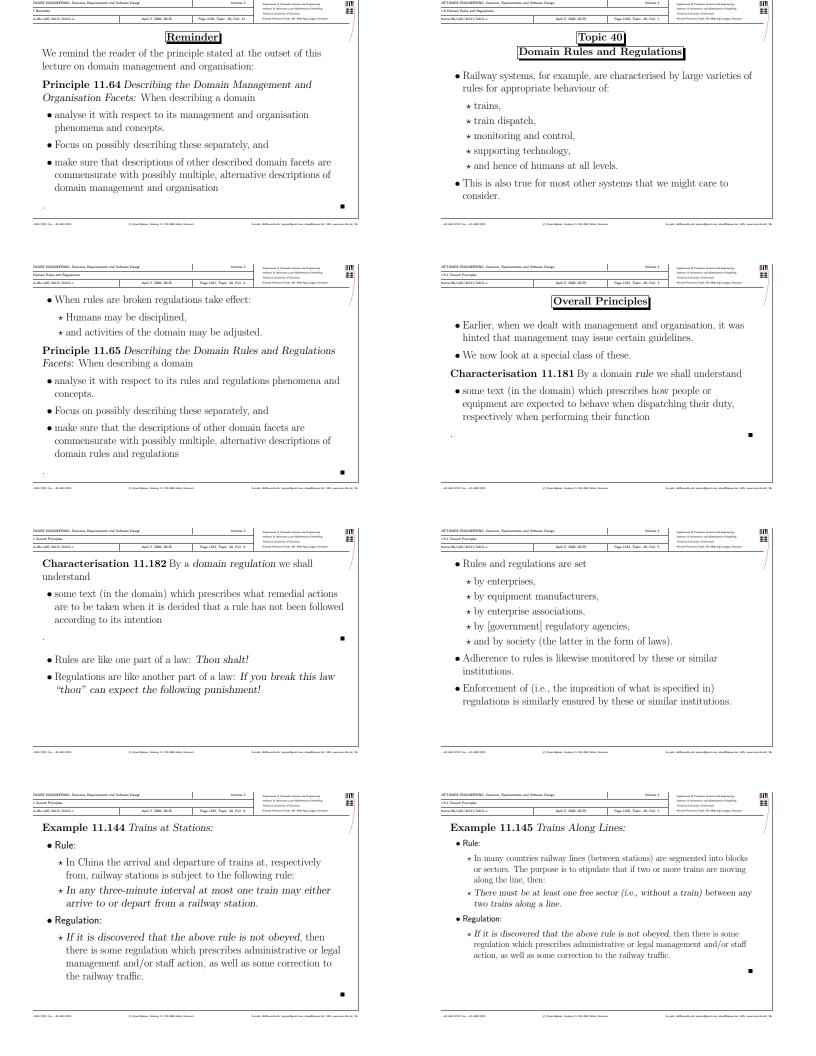
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$ type T, TN P = U^* $	Example 11.141 Air Traffic Control: We first refer to Example 11.129. Then we make the following remarks:
NetTraffic == net:N trf:(TN $_{\overline{m}}$ P) iTF = T \rightarrow NetTraffic sTF = T $_{\overline{m}}$ NetTraffic oG = iTF \rightarrow sTF	• The particular decomposition of air traffic control into the domain described, the ground, terminal, area and continental (monitoring and) control centres, represents but one composition of technologies.
value [close] c: NetTraffic × TN × NetTraffic \rightarrow Bool axiom \forall itt:iTF, og:OG · let stt = og(itt) in \forall t:T · t \in dom stt · t $\in D$ itt $\wedge \forall$ Tn:TN · tn \in dom trf(itt(t)) \Rightarrow tn \in dom trf(stt(t)) \wedge c(itt(t),tn,stt(t)) end	* The pragmatics, i.e., the assumptions underlying that combined ground, terminal, area and continental control centre support technology is that all monitoring and control was to take place from the ground.
Checkability is an issue of testing the optical gates when delivered for conformance to the close ness predicate, i.e., to the axiom.	
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• Future technologies, easily implementable today, facilitate the following alternative "sum total" technologies:	hemeleh yedil (26.11.126) April 12.2006, 69.35 Paper 122, Tapic 38, Fail 15 Robert Preuest Pails, Cold Registrative Devices
 * Most, if not all, of the human guidance that today takes place at these control centres can be automated and physically moved • either to fixed space-positioned satellites, • or to each aircraft itself. * Intermediate support technologies shall then feature solutions that are intermediary to the present and the future support technologies. 	 Techniques 43 • The support technologies model of a domain is a partial specification, hence all the usual abstraction and modelling principles, techniques and tools apply. More specifically, • support technologies (st:ST) "implement" intrinsic contexts and states: θ_i : Θ_i in terms of "actual" contexts and states: θ_a : Θ_a: type Θ_i, Θ_a ST = Θ_i → Θ_a axiom
455 220, For +6 633 251 © Directigens, Folders 11, DK 369 Nahr, Densak Ersels, define-das, d. Speerfignalism, demByzer 10; US: was involut A/ 26	$\forall \text{ sts:ST-set}, \text{ st:ST} \cdot \text{st} \in \text{sts} \Rightarrow \forall \theta_i : \Theta_i, \exists \theta_a : \Theta_a \cdot \text{st}(\theta_i) = \theta_a$
DVARE_ENCONCERNOR, Denzime, Requirements and Schwen Design Volume 3 Department of Comparison of Companying DVI Schward Schward,	OFTWARE ENCINEERING. Demains, Requirements and Software Design Volume 3 Degratery d'orques Groupes Expansion, 14.2 Methodological Consequences Technical Media de Marcine au Materiana Mathematica Media de Marcine au Materiana Mathematica Media de Marcine Software Design (Section 2014), Technical Media (Section 2014), Manuel May (MII), 2011; Marcine Media (Section 2014), Marcine Media (Section 2014),
• The formal requirements can be narrated:	• Support technology is not a refinement, but an extension.
★ Let Θ_i and Θ_a designate the spaces of intrinsic and actual-world configurations (contexts and states).	• Support technology typically introduces considerations of
 ★ For each intrinsic configuration model — that we know is support technology assisted — 	 * technology accuracy * fault tolerance * accessability * safety *
 ★ there exists a support technology solution, ★ that is, a total function from all intrinsic configurations to corresponding actual configurations. 	• Axioms characterise members of the set of support technologies (sts).
 If we are not convinced that there is such a function then there is little hope that we can trust this technology 	• An example axiom was given in the optical gate example (Example 11.140).
· •	
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 Principles 11.60 The support technology principle is relative to all other domain facets. It expresses that one must first describe essential intrinsics. 	 Generally the principle states that one must always be on the look / out for and inspire new support technologies. The most abstract form of the principle is: What is a support
It expresses that one must first describe essential intrinsics.Then it expresses that support technology is any means of implementing concrete instantiations	• The most abstract form of the principle is: What is a support technology one day becomes part of the domain intrinsics a future day.
 * of some intrinsics, * of some management and organisation, * and/or of some rules and regulations, * and so on 	
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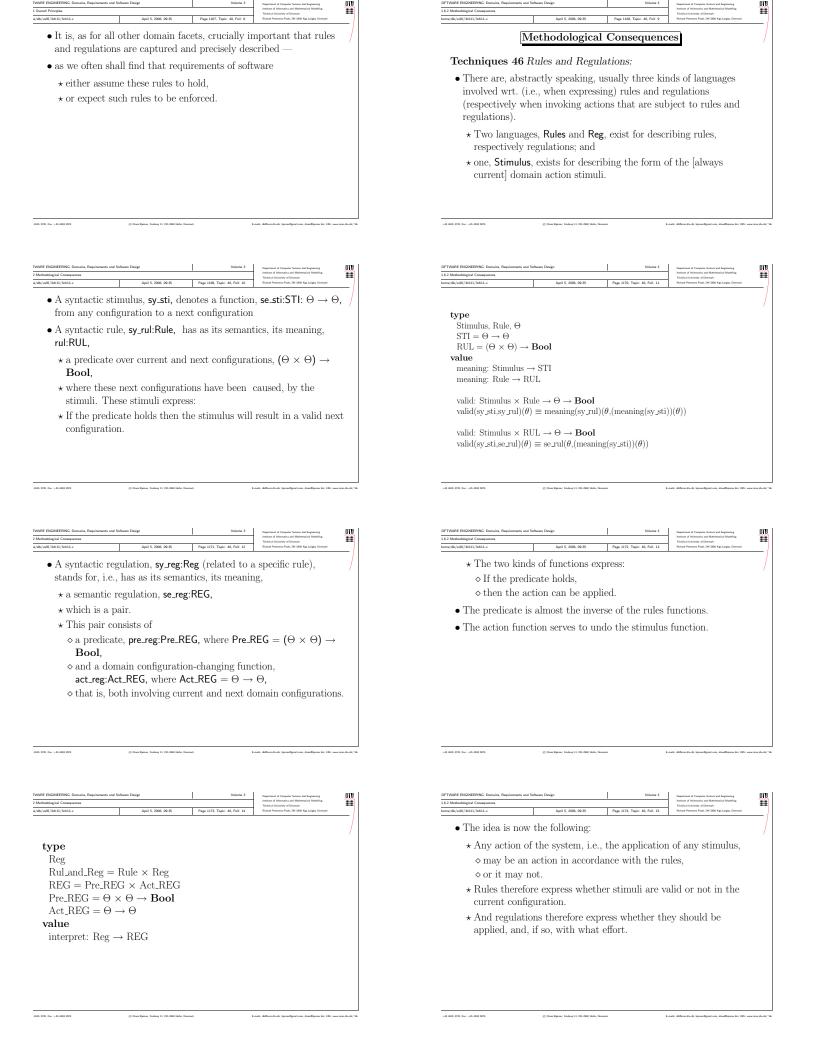
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Discussion	Reminder /
• The support technology descriptions reappear in the requirements definitions:	We remind the reader of the principle stated at the outset of this lecture on domain support technologies:
* as projected, instantiated, extended and initialised .	Principle 11.61 Describing the Domain Support Technologies Facets: When describing a domain
• In the domain description we only record our understanding of aspects of support technology failures.	• analyse it with respect to its support technology phenomena and concepts,
• In the requirements definition we then follow up and make decisions as to which kinds of breakdowns the computing system, the	• focus on possibly describing these separately, and
machine, is to handle, and what is to be achieved by such handling.	• make sure that descriptions of other described domain facets are commensurate with possibly multiple, alternative descriptions of domain support technologies
	· •
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Topic 39 Domain Management and Organisation	Principle 11.62 Describing the Domain Management and Organisation Facets: When describing a domain
• It is a basic characteristic of human-made systems	 analyse it with respect to its management and organisation phenomena and concepts.
• that they are managed by humans	• Focus on possibly describing these separately, and
 and that their management and the managed are structured in organisational structures. This lecture is about how we model this facet.	• make sure that descriptions of other described domain facets are commensurate with possibly multiple, alternative descriptions of domain management and organisation
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Overall Principles	Example 11.142 Train Monitoring, I:
• Activities of some (application) domains are made up by the actions of many people.	• In China, as an example, rescheduling of trains occurs at stations and involves telephone negotiations with neighbouring stations ("", and down the line")
• It is therefore common to organise these into levels of management and many groups of "floor", i.e., nonmanagement staff.	 ("up and down the lines"). Such rescheduling negotiations, by phone, imply reasonably strict management and organisation (M&O). This kind of M&O reflects
• Railway systems are usually characterised by highly structured management organisations, and rules and regulations set up by upper echelons of management to be followed by lower levels and by ground staff and users.	the geographical layout of the rail net.
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understand such people (such decisions)who (which) determine, formulate and thus set standards (cf. rules	orders cum decisions; • and who "backstop" complaints from lower management levels and
and regulations, a later lecture topic) concerning	from floor staff
\star strategic, tactical and operational	•
decisions;who ensure that these decisions are passed on to (lower) levels of	• In Example 9.95 we illustrated the distinctions indicated in the above characterisation of management between strategies, tactics
management, and to floor staff;who make sure that such orders, as they were, are indeed carried	and operations.
out;	

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Characterisation 11.180 By domain organisation we shall	• and hence the "lines of command":
inderstand	\star who does what, and
• the structuring of management and nonmanagement staff levels;	\star who reports to whom,
• the allocation of	\diamond administratively and
\star strategic,	\diamond functionally
\star tactical and	
\star operational	
concerns to within management and nonmanagement staff levels;	
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xample 11.143 Railway Management and Organisation: Train Monitoring,	• By an incoming and an outgoing line we mean part of a line between two stations, the remaining part being handled by neighbouring station management.
• Certain (lowest-level operational and station-located) supervisors are responsible	• Once it has been decided, by such a manager, that a train is not following its
for the day-to-day timely progress of trains within a station and along its incoming and outgoing lines, and according to given timetables.	schedule, based on information monitored by nonmanagement staff,
These	• then that manager directs that staff:
* supervisors	★ to suggest a new schedule for the train in question, as well as for possibly affected other trains, ★ to negotiate the new schedule with appropriate neighbouring stations, until a proper
★ supervisors ★ and their immediate (middle-level) managers (see below for regional	reschedule can be decided upon, by the managers at respective stations,
managers)	\star and to enact that new schedule.
set guidelines (for local station and incoming and outgoing lines)	 A (middle-level operations) manager for regional traffic, i.e., train traffic involving several stations and lines, resolves possible disputes and conflicts.
\star for the monitoring of train traffic,	involving sectoral stations and intes, resolves possible disputes and connects.
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The above, albeit rough-sketch description, illustrated the following /	A Conceptual Analysis, I
management and organisation issues:★ There is a set of lowest-level (as here: train traffic scheduling and	• People staff enterprises, the components of infrastructures with
rescheduling) supervisors and their staff.	which we are concerned, i.e., for which we develop software.
\star They are organised into one such group (as here: per station).	• The larger these enterprises — these infrastructure components —
\star There is a middle-level (as here: regional train traffic scheduling	the more need there is for management and organisation.
and rescheduling) manager (possibly with some small staff),	• The role of management is roughly twofold:
 * organised with one such per suitable (as here: railway) region. * The guidelines issued jointly by local and regional () supervisors and managers imply an organisational structuring of lines of information provision and command. 	
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- ef 681 804 💿 Don Ugene, Fraksij 11, DK 306 Halo, Donard Erach definendin-de, Sporefgeal and, dienflywer Six, UR, was zon der, de/ de	
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Contraction, Requirements and Software During Values 3 and Andreich. 1 Summary Contract Control of Contro	1323 A Compared Margin.1 April 5, 2006, 09.36 Page 1142, Taple: 36, 161.14 Main of Markow and Markows Markows Main and Markows Mar
CONCERNIC Density, Requirements and Software Dasign Values 1 und Analysis, 1 April 5, 2006, 09.36 Page 1141, Type: 35, Tabl. 11 * first, to perform strategic, tactical and operational work, to set strategic, tactical and operational policies — and to see to it that they are followed. * The role of management is, second, to react to adverse conditions, that is, to unforeseen situations, and to decide how	1323 Compared torque1 April 5 206 (0.5 ft Page 1142, Taple 20, for 14 With a Vision and an of the source and a vision and vision and a vision and
CONCEPTING: Domains: Requirements and Software Datage Values 3 Intel Adapts, 1 April 5, 2006, 49.56 Statt/Johall-w April 5, 2006, 49.56 * first, to perform strategic, tactical and operational policies — and to see to it that they are followed. * The role of management is, second, to react to adverse conditions, that is, to unforeseen situations, and to decide how they should be handled, i.e., conflict resolution.	1323 A Compared Morphil.1 April 5.2066 (09.16 Page 1142, Taple: 30, 161 in Main of Morphile Morphi
CHEEENCE Dimeter Requirements and Software Design Values 3 Total and Advance.1 ** first, to perform strategic, tactical and operational work, to set strategic, tactical and operational policies — and to see to it that they are followed. * The role of management is, second, to react to adverse conditions, that is, to unforeseen situations, and to decide how they should be handled, i.e., conflict resolution. Policy setting should help nonmanagement staff operate normal situations — those for which no management interference is thus	1512 A Computer Analysis April 5.2066 (0.05) Page 1162, Taple: 20, Fail 14 With an of Markin and Marking M
NUMBER Values 3 Displayer of Graphs have and Equipments DIFF mark Analysis 1 Apert 5 2006 39 B Page 1141. Taple 38. Feb 1 31 The standard of Taple Analysis 1	1312 A Compared Margin.1 April 5.306.40.35 Page 110, Taple: 30, Fail 14 Main of Mainian designed Margin, Main of Mainian designed Margin, Main and Mainian designed Margin, Main of Mainian designed Margin,
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stf: i:Sx $\rightarrow \Sigma \rightarrow in,out ms[i]$ Unit stf(i)(σ) \equiv	• Both manager and staff processes recurse (i.e., iterate) over possibly changing states.
(1) (let msg = ms[i]? in stf(i)(stf.in(msg)(σ)) end)	• The management process nondeterministically, external choice,
	"alternates" between "broadcast"-issuing orders to staff and
(2) (let $(\sigma', msg) = stf_out(\sigma)$ in $ms[i]!msg; stf(i)(\sigma')$ end)	receiving individual messages from staff.
stf_in: MSG $\rightarrow \Sigma \rightarrow \Sigma$,	 Staff processes likewise nondeterministically, external choice, alternate between receiving orders from management and issuing
stf_out: $\Sigma \to \Sigma \times MSG$	individual messages to management.
	• The conceptual example also illustrates modelling stakeholder
	behaviours as interacting (here $CSP\text{-like})$ processes.
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Vell (Johl J) Zahl-iv April 5, 2006, 09:35 Page 1153, Topic: 30, Fail: 25 Kitual Passan Paul, British Paul	1.5.5 Muthological Consequences, III Technol And Construction Strategy and Consequences, III Technol And Construct Moning Technol An
Methodological Consequences, III	Principles 11.63 The management and organisation principle expresses that relations between resources, and decisions
• The strategic, tactical and operations resource management	• to acquire and dispose resources,
example of Example 9.95 (foils 808–826) illustrated another management and organisation description pattern.	• to deschedule, reschedule and schedule resources,
\star It is based on a set of, in this case, recursive equations.	• to deallocate, reallocate and allocate resources and
* Any way of solving these equations, finding a suitable fix point,	• to deactivate, reactivate and activate resources,
or an approximation thereof, including just choosing and imposing an arbitrary "solution", reflects some management	are
communication.	
* The syntactic ordering of the equations — in this case a linear passing of enterprise results from upper equations onto lower equations — reflects some organisation.	
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are	Techniques 45 Management and Organisation:
• the prerogatives of well-functioning management,	• We have already, under techniques for modelling stakeholder and
• reflect a functioning organisation and	stakeholder perspectives, mentioned some of the techniques.
• imply invocation of procedures that are modelled as actions that	• Two extremes were shown:
* "set up"	\star Earlier we modelled individual management groups by
* and "take down"	\diamond their respective functions (strm, trm, orm), and
contexts and change states.	♦ their interaction (i.e., organisation) by solutions to a set of
As such, these principles tell us which subproblems of development to	recursive equations! • We can, amongst several styles, model management and
•	• We can, amongst several styles, model management and organisation, especially the latter, by communicating sequential behaviours
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Appl 112/3b11/3b11-irr Appl 1 2005, 50:35 Page 1137, Type: 38, Fail: 32 Bitware Paint, 50:300 Page Lange, Dawat Discussion	• These may partially handle logic characterisations of the strategic
• The domain models of management and organisation eventually	and tactical management functions.They might then do so in the form of computerised support of
 find their way into requirements and, hence, the software design — for those cases in which the requirements are about computing 	message passing between the various management groups (of, for
support of management and its organisation.	example, that stakeholder example), as well as of the generic example of the present part.
• Support in the solution of the recursive equations of the earlier stakeholder example (Example 9.95 Resource Management) may be offered in the form of constraint-satisfaction solvers.	
5 120, Far: +15 693 9374 (c) Direc Egener, Fredory 11, Dr.2493 Helter, Dennak Frazil: dellens.du.de, Ejerner@pazil.com, danz@pierne.biz; UR: www.iern.du.dl./'di	+66 455 2723, Fac: +66 4583 0574 (2), Dires Rigmer, Frankrij II., Dir. 3468 Hährs, Disenads E-mailte defferendra da, kjeneroffgenal com, direbligane kite, (DII: www.imm.dr.d.d./"d

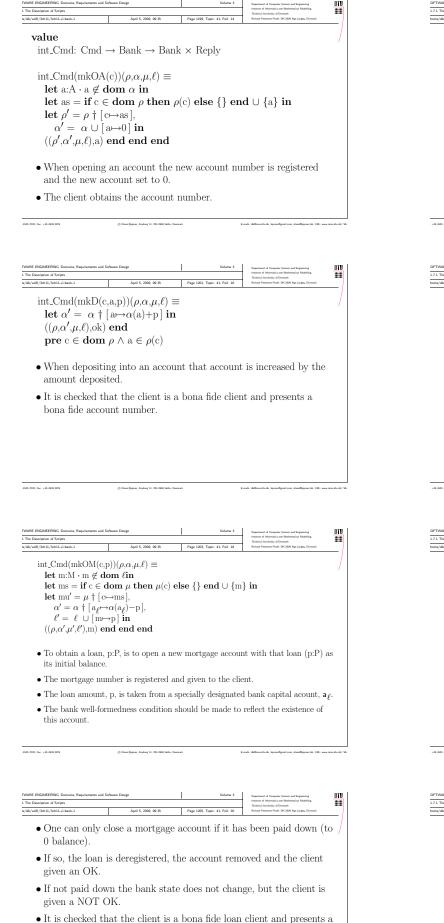




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• More specifically,	1
\star there is usually, in any current system configuration, given a set of pairs of	axiom
rules and regulations. * Let (sy_rul,sy_reg) be any such pair.	\forall (sy_rul,sy_reg):Rul_and_Regs \cdot
* Let sy_st be any possible stimulus.	let se_rul = meaning(sy_rul),
* And let θ be the current configuration.	$(\text{pre}_\text{reg}, \text{act}_\text{reg}) = \text{meaning}(\text{sy}_\text{reg})$ in \forall sy_sti:Stimulus, $\theta:\Theta$.
\star Let the stimulus, sy_sti , applied in that configuration result in a next	\sim valid(sy_sti,se_rul)(θ)
configuration, θ' , where $\theta' = (\text{meaning(sy_sti)})(\theta)$.	$\Rightarrow \text{pre_reg}(\theta, (\text{meaning}(\text{sy_sti}))(\theta))$
* Let θ' violate the rule, \sim valid(sy_sti,sy_rul)(θ),	$\Rightarrow \exists n\theta:\Theta \cdot act_reg(\theta) = n\theta \land se_rul(\theta, n\theta)$
 * then if predicate part, pre_reg, of the meaning of the regulation, sy_reg, holds in that violating next configuration, pre_reg(θ,(meaning(sy_sti))(θ)), 	end
* then the action part, act_reg, of the meaning of the regulation, sy_reg, must	
be applied, $act_reg(\theta)$, to remedy the situation.	
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• It may be that the regulation predicate fails to detect applicability of regulations actions.	• We have given an outline of the basic conditions under which a set of rules and regulations must be designed.
• That is, the interpretation of a rule differs, in that respect, from the	• Whether they are, in actual life, designed, by people, and to be
interpretation of a regulation.	• whether they are, in actual me, designed, by people, and to be interpreted and followed by people, as described here is not for us to decide.
• Such is life in the domain, i.e., in actual reality	• Such concerns are the prerogatives of business process
•	reengineering and domain requirements
	• We will cover such concerns in later lectures.
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Rules and Regulation Languages	• It is inside the scope, but outside the span of these lectures to bring
• We have outlined the basic properties any set of rules and regulations must	in — as of 2006 — research material on this subject.
imply in a properly functioning organisation.	• In other words: Expect it to come, one day, probably couched in
• The axioms prescribed above are abstract.	terms of some modal logics of knowledge and belief, and/promise
	and commitment, etc.
• They also apply, inter alia, to natural language expressions of rules and	
	• We refer to the nice book by Fagin, Halpern, Moses and Vardi:
• They also apply, inter alia, to natural language expressions of rules and	• We refer to the nice book by Fagin, Halpern, Moses and Vardi: <i>Reasoning About Knowledge</i> .
They also apply, inter alia, to natural language expressions of rules and regulations.It would be nice if rules and regulations could be formalised.Then, given an appropriate model of the domain, one might be able to analyse	
 They also apply, inter alia, to natural language expressions of rules and regulations. It would be nice if rules and regulations could be formalised. Then, given an appropriate model of the domain, one might be able to analyse the consistency and completeness of rules and regulations with respect to the 	
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 They also apply, inter alia, to natural language expressions of rules and regulations. It would be nice if rules and regulations could be formalised. Then, given an appropriate model of the domain, one might be able to analyse the consistency and completeness of rules and regulations with respect to the domain model. 	Reasoning About Knowledge.
 They also apply, inter alia, to natural language expressions of rules and regulations. It would be nice if rules and regulations could be formalised. Then, given an appropriate model of the domain, one might be able to analyse the consistency and completeness of rules and regulations with respect to the domain model. 	Reasoning About Knowledge.
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Techniques 47 • <i>Rules and regulations</i> , in the domain, are / therefore domain-modelled	• Such rules and regulations modelling must allow for conflicts between rule and regulation interpretations:
 ★ by abstract or concrete syntaxes of syntactic rules, ★ by abstract types of denotations and 	\star that rules are interpreted to state that a next configuration is not valid.
* by semantics definitions, usually in the form of axioms or	* while a regulation (applicability) predicate does not hold.
denotation-ascribing functions.	• Stimuli, without here going into details, may be modelled by nondeterministic external events, i.e., CSP -like inputs
	· •
SI 202, Fac. +6 681 801 © Diste Egness, Federaj 11, De 386 Meis, Denack Enach de Brenduch, igner@gastions, derBijner laci, UR, was instalted / de	-efi 453 E20, Far -efi 463 E20
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Reminder / We remind the reader of the principle stated at the outset of this /	Topic 41 / Domain Scripts
lecture on domain rules and regulations:	
Principle 11.67 Describing the Domain Rules and Regulations	• Usually rules and regulations form a contract between levels of staff in an enterprise.
Facets: When describing a domain	• We may call these intrainstitutional rules and regulations.
• analyse it with respect to its rules and regulations phenomena and concepts.	 Rules that pertain * to contracts between, say, a private enterprise and its customers, or a
• Focus on possibly describing these separately, and	government and its citizens, \star often need be far more stringently phrased than intrainstitutional rules and
• make sure that the descriptions of other domain facets are	regulations.
commensurate with possibly multiple, alternative descriptions of domain rules and regulations	• We may call such rules legal rules and regulations.
. •	• Legal rules and regulations often need be scripted.
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Principle 11.68 Describing the Domain Script Facets: When	The Description of Scripts
describing a domain	Characterisation 11.183 By a domain <i>script</i> we shall understand
analyse it with respect to its script phenomena and concepts.Focus on possibly describing these separately, and	\bullet the structured, almost, if not outright, formally expressed, wording of
 rocus on possibly descriptions of other described domain facets are 	• a rule or a regulation that has legally binding power,
commensurate with possibly multiple, alternative descriptions of domain scripts	\bullet that is, which may be contested in a court of law . $\hfill\blacksquare$
	• Scripts are like programs.
	\star They are expected to prescribe step-by-step actions to be applied
	 ★ in order to determine whether a rule should be applied, ★ and, if so, exactly how it should be applied.
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Example 11.146 A Casually Described Bank Script, I: We	\star When a repayment occurs, then the following calculations shall
deviate, momentarily, from our line of railway examples, to exemplify one from banking. Our formulation amounts to just a (casual) rough	take place:
sketch. It is followed by a series of four large examples. Each of these	♦ the interest on the balance of the loan since the most recent repayment,
elaborate on the theme of (bank) scripts.	 ◆ the handling fee, normally considered fixed,
• The problem area is that of how repayments of mortgage loans are to be calculated.	 ♦ the effective repayment ● being the difference between the repayment
* At any one time a mortgage loan has	• — being the difference between the repayment • and the sum of the interest and the handling fee —
 At any one time a mortgage toan has ◊ a balance, 	\diamond and the new balance,
\diamond a most recent previous date of repayment,	• being the difference between the old balance
♦ an interest rate and	\circ and the effective repayment.
♦ a handling fee.	
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* We assume repayments to occur from a designated account, say	\star Finally, one must also describe deviations such as /
a demand/deposit account.	♦ overdue repayments,
\star We assume that bank to have designated fee and interest income accounts.	♦ too large, or too small repayments,
★ The interest is subtracted from the mortgage holder's	\diamond and so on.
demand/deposit account and added to the bank's interest	•
(income) account.	• The idea about scripts is that they can somehow be objectively
* The handling fee is subtracted from the mortgage holder's	enforced:
demand/deposit account and added to the bank's fee (income)	\star that they can be precisely understood
account.	\star and consistently carried out by all stakeholders,
\star The effective repayment is subtracted from the mortgage holder's	\star eventually leading to computerisation.
demand/deposit account and also from the mortgage balance.	\star But they are, at all times, part of the domain.
	x Dut they are, at an times, part of the domain.
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1 The Description of Scripts The Institute of Normal Scripts April 1 (Section 2014) (Section 201	1.7.1 The Description of Scripts Intelliar 4 Standards Massing Technology (1) (2) (2) (2) (2) (2) (2) (2) (2) (2) (2
Example 11.147 Bank Scripts, II:	type
• Without much informal explanation, i.e., narrative, we define a	C, A, M
• Without much mormal explanation, i.e., narrative, we define a small bank.	$AY' = \mathbf{Real}, AY = \{ ay: AY' \cdot 0 < ay \le 10 \}$
\star One can open and close demand/deposit accounts.	$MI' = \mathbf{Real}, MI = \{ mi:MI' \cdot 0 < mi \le 10 \}$
* One can obtain and close demand/deposit accounts. * One can obtain and close mortgage loans, i.e., obtain loans.	$Bank' = A_Register \times Accounts \times M_Register \times Loans$
	$Bank = \{ \beta:Bank' \cdot wf_Bank(\beta) \}$
★ One can deposit into and withdraw from demand/deposit accounts.	A_Register = $C \overrightarrow{m}$ A-set
	Accounts = A πi Balance M_Register = C πi M-set
\star And one can make payments on the loan.	$ \text{Loans} = M \overrightarrow{m} (\text{Loan} \times \text{Date}) $
• In this example we illustrate informal rough-sketch scripts	Loan.Balance = P
• while also formalising these scripts.	P = Nat
455 5721, Fac + 66 418 801 © Direc Bjann, Freding II, Dir SHR Halte, Denask Eraile dellere durch, hjererligenslam, derethijene biz 152, www.inen.dur.dl/d	: +66 455 372, Fac: +6 483 674 🛞 Diese Rjewer, Federal II, 05/346 Halte, Damask 🕹 ranke dellem dar. de Japonel para Leo, developinen bie, URI: waw inne dar. de J
TWARE ENCINEERING. Domains, Regularements and Software Design Volume 3 Department of Computer Science and Engineering URL Software Design Volume 3 Institute of Informatic and Engineering Volume 3 Institute of Informatic and Institute of Informatic and Informatic and Institute of Informatic and Institute of Informatic and Informatic and Institute of Informatic and Institute of Informatic and Institute of Instituteo Insti	OFTWARE ENGINEERING. Domains, Requirements and Software Design Volume 3 Department d'ampute Science au Engineering United au Materiale
1 The Description of Scripts Internet Automatical Mitimized Automa	1.7.1 The Description of Scripta Test Test Scripta Test Scripta Test Scripta Test Scripta Test Scripta Test Scripta Sc
value	• We assume
ay:AY, mi:MI	
	* a fixed yield, ai , on demand/deposit accounts,
wf_Bank: Bank \rightarrow Bool	\star and a fixed interest, $mi,$ on loans.
wf_Bank $(\rho, \alpha, \mu, \ell) \equiv \cup \operatorname{\mathbf{rng}} \rho = \operatorname{\mathbf{dom}} \alpha \land \cup \operatorname{\mathbf{rng}} \mu = \operatorname{\mathbf{dom}} \ell$	• A bank is well-formed
axiom	\star if all accounts named in the accounts register are indeed
ai <mi< td=""><td>accounts,</td></mi<>	accounts,
	\star and all loans named in the mortgage register are indeed
	mortgages.
	\star No accounts and no loans exist unless they are registered.
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TWMEE ENCINEERING. Domains, Requirements and Software Design Volume 3 Description Difference Difference 1 The Description of Scripts Test Compare Control of Scripts Test Compare Control of Scripts Test Compare Control of Scripts Test Control of Scripts	OFTWARE ENGINEERING: Domains, Requirements and Software Design Volume 3 Depondent of Software Original Software Design Softwar
1 Ihi Usecreption of Screpta Technical Usionsity of Dennak Technical Usionsity of Dennak (Di-Stand Penessee Plan, Di-Stand Pen	1.7.1 The Description of Scripts Testing and American Manney Testing and American Mann
type	• The client can issue the following commands:
type Cmd = OpA CloA Dep Wdr OpM CloM Pay	• The client can issue the following commands:
	\star Open Account,
Cmd = OpA CloA Dep Wdr OpM CloM PayOpA == mkOA(c:C)CloA == mkCA(c:C,a:A)	★ Open Account,★ Close Account,
Cmd = OpA CloA Dep Wdr OpM CloM Pay OpA == mkOA(c:C)	 * Open Account, * Close Account, * Deposit monies (p:P),
$\begin{split} \mathbf{Cmd} &= \mathrm{OpA} \mid \mathrm{CloA} \mid \mathrm{Dep} \mid \mathrm{Wdr} \mid \mathrm{OpM} \mid \mathrm{CloM} \mid \mathrm{Pay} \\ \mathrm{OpA} &== \mathrm{mkOA}(\mathrm{c:C}) \\ \mathrm{CloA} &== \mathrm{mkCA}(\mathrm{c:C,a:A}) \\ \mathrm{Dep} &== \mathrm{mkD}(\mathrm{c:C,a:A,p:P}) \\ \mathrm{Wdr} &== \mathrm{mkW}(\mathrm{c:C,a:A,p:P}) \end{split}$	 * Open Account, * Close Account, * Deposit monies (p:P), * Withdraw monies (p:P),
Cmd = OpA CloA Dep Wdr OpM CloM PayOpA == mkOA(c:C)CloA == mkCA(c:C,a:A)Dep == mkD(c:C,a:A,p:P)Wdr == mkW(c:C,a:A,p:P)OpM == mkOM(c:C,p:P)	 * Open Account, * Close Account, * Deposit monies (p:P), * Withdraw monies (p:P), * Obtain loans (of size p:P) and
Cmd = OpA CloA Dep Wdr OpM CloM PayOpA == mkOA(c:C)CloA == mkCA(c:C,a:A)Dep == mkD(c:C,a:A,p:P)Wdr == mkW(c:C,a:A,p:P)OpM == mkOM(c:C,p:P)Pay == mkPM(c:C,a:A,m:M,p:P)	 * Open Account, * Close Account, * Deposit monies (p:P), * Withdraw monies (p:P), * Obtain loans (of size p:P) and * Pay installations on loans (by transferring monies from an
Cmd = OpA CloA Dep Wdr OpM CloM Pay OpA == mkOA(c:C) CloA == mkCA(c:C,a:A) Dep == mkD(c:C,a:A,p:P) Wdr == mkW(c:C,a:A,p:P) OpM == mkOM(c:C,p:P) Pay == mkPM(c:C,a:A,m:M,p:P) CloM == mkCM(c:C,m:M,p:P)	 * Open Account, * Close Account, * Deposit monies (p:P), * Withdraw monies (p:P), * Obtain loans (of size p:P) and * Pay installations on loans (by transferring monies from an account).
$\begin{split} \mathbf{Cmd} &= \mathrm{OpA} \mid \mathrm{CloA} \mid \mathrm{Dep} \mid \mathrm{Wdr} \mid \mathrm{OpM} \mid \mathrm{CloM} \mid \mathrm{Pay} \\ \mathrm{OpA} &== \mathrm{mkOA}(\mathrm{c:C}) \\ \mathrm{CloA} &== \mathrm{mkCA}(\mathrm{c:C,a:A}) \\ \mathrm{Dep} &== \mathrm{mkD}(\mathrm{c:C,a:A,p:P}) \\ \mathrm{Wdr} &== \mathrm{mkW}(\mathrm{c:C,a:A,p:P}) \\ \mathrm{OpM} &== \mathrm{mkOM}(\mathrm{c:C,a:A,p:P}) \\ \mathrm{Pay} &== \mathrm{mkPM}(\mathrm{c:C,a:A,m:M,p:P}) \\ \mathrm{CloM} &== \mathrm{mkCM}(\mathrm{c:C,m:M,p:P}) \\ \mathrm{Reply} &= \mathrm{A} \mid \mathrm{M} \mid \mathrm{P} \mid \mathrm{OkNok} \end{split}$	 * Open Account, * Close Account, * Deposit monies (p:P), * Withdraw monies (p:P), * Obtain loans (of size p:P) and * Pay installations on loans (by transferring monies from an
Cmd = OpA CloA Dep Wdr OpM CloM PayOpA == mkOA(c:C)CloA == mkCA(c:C,a:A)Dep == mkD(c:C,a:A,p:P)Wdr == mkW(c:C,a:A,p:P)OpM == mkOM(c:C,p:P)Pay == mkPM(c:C,a:A,m:M,p:P)CloM == mkCM(c:C,m:M,p:P)	 * Open Account, * Close Account, * Deposit monies (p:P), * Withdraw monies (p:P), * Obtain loans (of size p:P) and * Pay installations on loans (by transferring monies from an account).
$\begin{split} & \operatorname{Cmd} = \operatorname{OpA} \mid \operatorname{CloA} \mid \operatorname{Dep} \mid \operatorname{Wdr} \mid \operatorname{OpM} \mid \operatorname{CloM} \mid \operatorname{Pay} \\ & \operatorname{OpA} == \operatorname{mkOA}(\operatorname{c:C}) \\ & \operatorname{CloA} == \operatorname{mkCA}(\operatorname{c:C},\operatorname{a:A}) \\ & \operatorname{Dep} == \operatorname{mkD}(\operatorname{c:C},\operatorname{a:A},\operatorname{p:P}) \\ & \operatorname{Wdr} == \operatorname{mkW}(\operatorname{c:C},\operatorname{a:A},\operatorname{p:P}) \\ & \operatorname{OpM} == \operatorname{mkOM}(\operatorname{c:C},\operatorname{c:P}) \\ & \operatorname{Pay} == \operatorname{mkPM}(\operatorname{c:C},\operatorname{a:A},\operatorname{m:M},\operatorname{p:P}) \\ & \operatorname{CloM} == \operatorname{mkCM}(\operatorname{c:C},\operatorname{m:M},\operatorname{p:P}) \\ & \operatorname{Reply} = A \mid M \mid P \mid \operatorname{OkNok} \end{split}$	 * Open Account, * Close Account, * Deposit monies (p:P), * Withdraw monies (p:P), * Obtain loans (of size p:P) and * Pay installations on loans (by transferring monies from an account).
$\begin{split} & \operatorname{Cmd} = \operatorname{OpA} \mid \operatorname{CloA} \mid \operatorname{Dep} \mid \operatorname{Wdr} \mid \operatorname{OpM} \mid \operatorname{CloM} \mid \operatorname{Pay} \\ & \operatorname{OpA} == \operatorname{mkOA}(\operatorname{c:C}) \\ & \operatorname{CloA} == \operatorname{mkCA}(\operatorname{c:C},\operatorname{a:A}) \\ & \operatorname{Dep} == \operatorname{mkD}(\operatorname{c:C},\operatorname{a:A},\operatorname{p:P}) \\ & \operatorname{Wdr} == \operatorname{mkW}(\operatorname{c:C},\operatorname{a:A},\operatorname{p:P}) \\ & \operatorname{OpM} == \operatorname{mkOM}(\operatorname{c:C},\operatorname{c:P}) \\ & \operatorname{Pay} == \operatorname{mkPM}(\operatorname{c:C},\operatorname{a:A},\operatorname{m:M},\operatorname{p:P}) \\ & \operatorname{CloM} == \operatorname{mkCM}(\operatorname{c:C},\operatorname{m:M},\operatorname{p:P}) \\ & \operatorname{Reply} = A \mid M \mid P \mid \operatorname{OkNok} \end{split}$	 * Open Account, * Close Account, * Deposit monies (p:P), * Withdraw monies (p:P), * Obtain loans (of size p:P) and * Pay installations on loans (by transferring monies from an account).



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int_Cmd(mkC let $\rho' = \rho \ddagger$ $\alpha' = \alpha \setminus$ $((\rho', \alpha', \mu, \ell), \eta$ pre $c \in$ do	$\begin{array}{c} [c \mapsto \rho(c \\ \{a\} \text{ in} \\ \alpha(a)) \text{ en} \end{array}$	e)\{a}], nd			/
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• It is checked bona fide ac			bona fide client	and presents a	
				that if an account at of that number.	
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than that de	0	0		int is not larger	/
	-			he named account.	
	l that the	e client is a	bona fide client		
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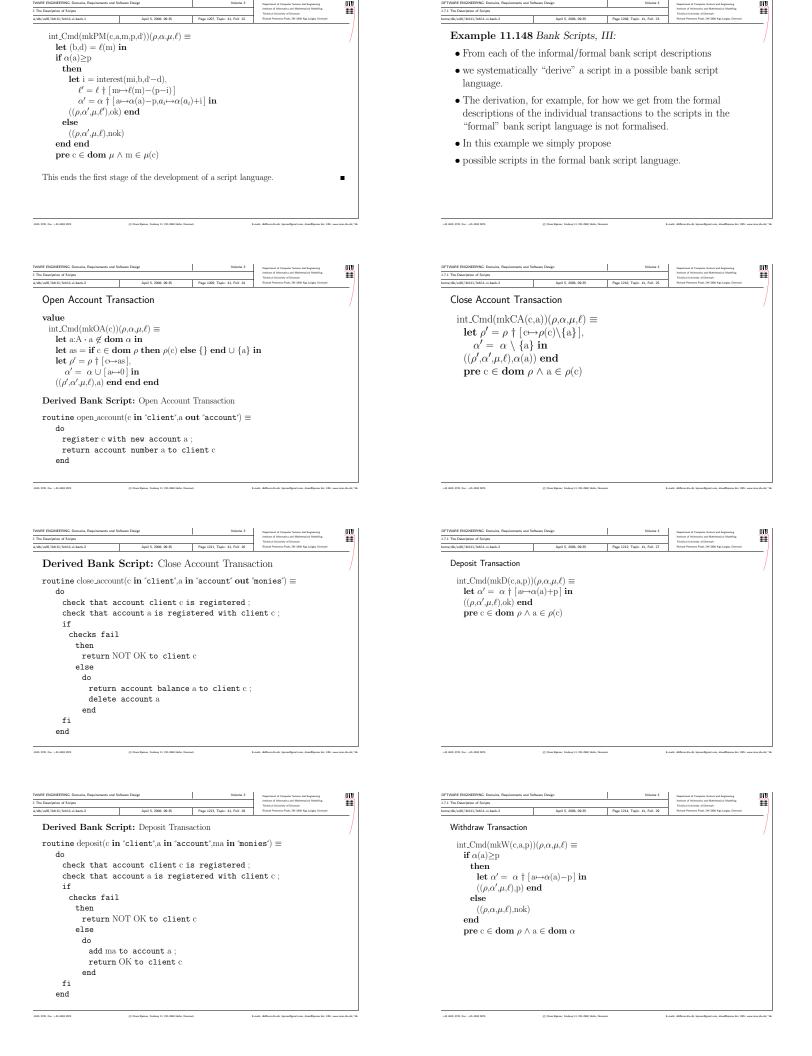
1.7.1 The Description of Scripts		,	Institute of Informatics and Mathematical Modelling Technical University of Denmark
home/db/volll/3ch11/3ch11-vi-bank-1	April 5, 2006, 09:35	Page 1206, Topic: 41, Foil: 21	Richard Petersens Plads, DK-2000 Kgs.Lyngby, Denmark
 To pay off a loan is was paid. 	to pay the interest of	on the loan since t	the last time interest
• That is, interest, i , d' - d, at the rate		balance, b , of the	loan for the period
\bullet (We omit defining	he interest computa	tion.)	
1 5 7 1 7	taken from the clien st earning account) a	/ 1	it account, a ; i is paid diminished with the
• It is checked that t mortgage account n		le loan client and	presents a bona fide
• The bank well-form	adness condition she	uld he mede to r	

 \bullet The bank well-formedness condition should be made to reflect the existence of account $a_i.$

bona fide mortgage account number.

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• except for the first two statements.

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OFTWARE ENGINEERING: Domains, Requirements and So	oftware Design	Volume 3	Department of Computer Science and Engineering DTU
1.7.1 The Description of Scripts			Institute of Informatics and Mathematical Modelling Technical University of Desmark
home/db/voll1/3ch11/3ch11-vi-bank-2	April 5, 2006, 09:35	Page 1216, Topic: 41, Foil: 31	Richard Petersens Plads, DK-2800 Kgs.Lyngby, Denmark
Obtain Loan Transactio	n		/
int_Cmd(mkOM(c,p))	$(\rho, \alpha, \mu, \ell) \equiv$		
let m:M · m ∉ dor	n lin		
let $ms = if c \in do$	m μ then $\mu(c)$ else	$e \{\} end \cup \{m\}$	in
let $mu' = \mu \dagger [c \mapsto$. ()	
$\alpha' = \alpha \dagger [a_\ell \mapsto \alpha]$	17		
$\ell' = \ell \cup [m \mapsto p]$			
$((\rho, \alpha', \mu', \ell'), \mathbf{m})$ end	1		
$((\rho, \alpha, \mu, \epsilon), m)$ end	i end end		
Derived Bank Scrip	pt: Obtain Loan Tra	ansaction	
routine get_loan(c in	"client".p in "amou	nt".m out "loan	number") =
do		.,	,
register c with	loan m amount p;		
0	n account bank's		
*	mberm to client	-	
end	mber m co crient	C	
enu			

Volume 3 Z.11 The Description of Scripts		Volume 3	Institute of Informatics and Mathematical Modelling	
ms/db/volll/3ch11/3ch11-vi-bank-2	April 5, 2006, 09:35	Page 1218, Topic: 41, Foil: 33	Technical University of Denmark Richard Protesters Plads, DK-2800 Kgs.Lyngby, Denmark	
Derived Bank Script: (lose Loan Transactior	1		
routine close_loan(c in "cl	ient",m in "loan nu	$mber'') \equiv$		
do				
check that loan o	lient c is registe	red ;		
check that loan m	is registered wi	th client c ;		
check that loan m	has 0 balance;			
if				
checks fail				
then				
return NOT	OK to client c			
else				
do				
close loan	m			
return OK	to client c			
end				
fi				
end				

OFTWARE ENGINEERING: Domains, Requirements and Software Design Volume 3 1.7.1 The Description of Scripts			Department of Computer Science and Engineering Institute of Informatics and Mathematical Modelling
me/db/voll//3ch11/3ch11-vi-bank-2	April 5, 2006, 09:35	Page 1220. Topic: 41. Foil: 35	Technical University of Denmark Richard Petersons Plads, DK-2000 Kgs.Lyngby, Denmark
Derived Bank Script: Loa	n Payment Transaction	1	
routine pay_loan(c in "clien	nt",m in "loan number",p in	n "amount") \equiv	
	ient c is registered ;		
	is registered with clies	nt c :	
	a is registered with cl		
	a has p or more balance		
if	1		
checks fail			
then			
return NOT (OK to client c		
else			
do			
	terest i for loan m on d	ate d ;	
	-i from loan m ;		
	from account a ;		
	count bank's interest		
return OK end	to client c ;		
fi			
end			
ond			
This ends the second stage of	the development of a scrip	t language.	
45 4525 3720. Fax: +45 4593 0074	② Direct Rigmer, Fredovej 11, DK-2040 Halte, De		E-maile: de@mm.dtu.dk, bjørner@gmail.com, diree@bjørner.biz; URL: www.imm.d

1.7.1.1 Routine Headers			Institute of Informatics and Mathematical Modelling Technical University of Denmark
some/db/volll/3ch11/3ch11-vi-bank-3	April 5, 2006, 09:35	Page 1222, Topic: 41, Foil: 39	Richard Petersent Plats, DK-2000 Kgs.Lyngby, Denmark
close_account(c deposit(c in "cl withdraw(c in "	Routine in "client",a out in "client",a in " .ient",a in "accou client",a in "acco lient",p in "amou	t "account") account" out ' int",ma in "mon ount",ma in "ar	ies") nount" out "monies")
, , , , , , , , , , , , , , , , , , ,	client",m in "lo	an number")	,
close_loan(c in '		/	
· · · · · · · · · · · · · · · · · · ·	:lient",m ${f in}$ "loa	n number",p in	("amount")
· · · · · · · · · · · · · · · · · · ·	:lient",m in "loa	n number",p in	("amount")
· · · · · · · · · · · · · · · · · · ·	client",m in "loa	n number",p in	"amount")

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(db/vd8/2b11/2b11-shaneb-3 April 5, 2006, 00:25 Page 1223, Topic: 41, Fail: 40 Risked Pressee Pail, 04:308 Rp1:pdp; Demons	homy/db/vdll/2ht1/2ht1/2ht1/2ht1/2ht1/2ht1/2ht1/2ht1
routine name(v1 io "t",v2 io "t2",,vn io "tn") ≡	Example Statements
where:	do stmt_list end if test_expr then stmt else stmt fi
io = in out	register c with new account a register c with loan m amount p
and:	add p to account a
ti is any text	subtract p from account a subtract p-i from loan m add it a count hask is interest.
	add i to account bank's interest subtract p from account bank's loan capital add p to account bank's loan capital
	compute interest i for loan m on date d
	delete account a close loan m
	return ret_expr to client c
	check that check_expr
55 250, Far + 66 414 1014 💿 Eine Ngener, Frahn II, 105 246 Mate, Sweark Eine Na define du de, Hjener Gyraf ann, Genethjore Sci, 101, 101 define du de/ de	- 46 455 202, For + 66 463 801 C value for and for the Contract Co
ARE ENGINEERNG. Domains, Requirements and Software Design Volume 3 Department of Corpora Solar and Exploring DEP Example Expressions Toxic Understand Adding Test	OFTWARE ENGOMERENIC Domain, Requirements and Software Design Voluma 3 United and Compositions and Explaining United and United
April 5,2080, 00:35 Page 325, Tapic 41, Fail 42 Refuer Present Fails 00:388 Fail-tapic Denuit	anali man i man
Example Expressions	check_expr: /
test_expr:	account client c is registered
checks fail	account $a \; \mbox{is registered}$ with client c
	account a has p or more balance loan client c is registered
ret_expr:	loan m is registered with client c
account number a	loan m has 0 balance
account balance a	•
NOT OK	
OK	
p loan number m	
25 T25, Fac. + 64 401 801 © Development, Fached, 11, D5 208 Mah, Dennak Excel, Specific planter, Kandhag, Specific planter, Speci	-14.63.123, for +6.681.024 © Stree Spree Falsel (1, 152.306 Mat, Streed) & Evals & Bender, A. Spreefgerland, Kolenbyre (1), US, was not ask
NARE ENGINEERING. Domins, Requirements and Software Darign Volume 3 The Description of Scripts The Des	OFTWARE ENGINEERING: Domains, Requirements and Software Design Volume 3 17.2 Methodological Consequences Table 19 January
6b/vdll/2611/2611/2611/	home/db/vdll/3bh1/3bh1-ei April 5, 2006, 99-35 Page 1220, Topic: 41, Foil: 45 Rither/Homes/Pad, DK-300 Fajl-Laple, Denack
• Finally, in an example in the lecture notes, we establish a formal	Methodological Consequences
 semantics of the bank-friendly script language. Please read that yourselves 	• We have already covered
Please read that yourselves.	\star techniques for,
	★ techniques for,★ and principles of
	 * techniques for, * and principles of • describing (i.e., modelling) rules and regulations (Sects. and).
	★ techniques for,★ and principles of
	 * techniques for, * and principles of • describing (i.e., modelling) rules and regulations (Sects. and). • These carry over, but in stricter forms, to the description (incl. modelling) of scripts. • Designing script languages is basically like designing small programming
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 Facets: When describing a domain, analyse it with respect to its human behaviour phenomena and concepts. Focus on possibly describing these separately. Make sure that descriptions of other described domain facets are commensurate with possibly multiple, alternative descriptions of domain human behaviours and it describing a domain it is important to try capture salient features of what it means to be a human worker: being careful, diligent and accurate, being careful, diligent and accurate, being careful, diligent and accurate, being intentionally sloppy, being intentionally sloppy, being intentionally sloppy, being outright criminal and, if describable, any shade in-between. How one describes that, and, if describable, any shade in-between. How one describes that, and, if describable, any shade in-between. How one describes that, and, if describable, any shade in-between. How one describes that, and, if describable, any shade in-between. How one describes that, and, if describable, any shade in-between. How one describes that, and, if describable, any shade in-between. How one describes that, and the software developer, utilises such descriptions 	KgsLyngby, Denmark
 and you is with respect to its imman behaviour phenomena and concepts. Focus on possibly describing these separately. Make sure that descriptions of other descriptions of domain facets are commensurate with possibly multiple, alternative descriptions of domain human behaviours a and behaviours a substrated in Example 11.150 Banking — or Programming — Staff Behaviour: b being careful, diligent and accurate, is a programming — Staff Behaviour: b being careful, diligent and accurate, is being intentionally sloppy, b being careful, diligent and accurate, is being outright criminal and, if describable, any shade in-between. How w one describes that, and, if describable, any shade in-between. How w one describes that, and how one, i.e., the software developer, utilises such descriptions 	1 11
 • Outso on possibly used round, diligent and accurate, • Make sure that descriptions of other described domain facets are commensurate with possibly multiple, alternative descriptions of domain human behaviours • • • • • • • • • • • • • • • • • • •	e shall
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domain human behaviours * sloppy dispatch, and • delinquent work, to • outright criminal pursuit * outright criminal pursuit • In describing a domain it is important to try capture salient features of what it means to be a human worker: * being unitentionally sloppy, • being unitentionally sloppy, * being intentionally sloppy, • being outright criminal and, if describable, any shade in-between. • How • Mow * one describes that, • and how one, i.e., the software developer, utilises such descriptions * We would characterise a clerk as being sloppy if that possible to above.	
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 * being unintentionally sloppy, * being intentionally delinquent, * being outright criminal and, if describable, any shade in-between. • How * one describes that, * and how one, i.e., the software developer, utilises such descriptions say mortgage repayments, as illustrated in Example 11.140 * We would characterise such a clerk as being diligent, et person carefully follows the mortgage calculation rules, checks and double-checks that calculations "tally up", or others do so. • How * one describes that, * and how one, i.e., the software developer, utilises such descriptions 	
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 if that person systematically forgets these checks. * Me would call such a person a <i>criminal</i> if that person intentionally miscalculates in such a way that the bank (and/or the mortgage client) is cheated out of funds which, instead, may * We would characterise the programmer as being <i>diligent</i> if that person carefully follows the mortgage calculation rules, and throughout the development verifies and tests that the calculations are correct with the rules. * We would characterise the programmer as being <i>sloppy</i> if that person with the rules. 	respect to
 be diverted to the cheater. certain checks and tests when otherwise correcting the computing punder development. 	
charged with implementing an automatic routine for effecting mortgage repayments along the lines illustrated in Example 11.146: And we would characterise the programmer as being <i>delinquent</i> if that systematically forgets these checks and tests. And we would characterise the programmer as being a <i>criminal</i> if intentionally provides a program which miscalculates the mortgage etc., in such a way that the bank (and/or the mortgage client) is closed of funds.	-
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A consumers goods market consists of	place and an invoice is sent.
* consumers, retailers, wholesalers, producers and delivery services.	\star (v) The consumer may decide to return the merchandise unpaid,
• We focus just on possible consumer behaviours:	or even paid!
\star (i) a consumer inquires, with a retailer, as to availability, price,	\star (vi) Or the consumer may keep the merchandise and may ignore the invoice, or may pay it, or may pay some other "fictive" (i.e.,
and delivery terms, of some merchandise.	nonexisting) invoice.
\star (ii) The retailer responds with zero, one or more offers.	\star (vii) The consumer may then decide to return the merchandise for repair or for claims.
★ (iii) The consumer may decide to ignore the offers, or the consumer may select one of the offers, or the consumer may	for repair of for clambs.
order something that was not in the set of offers.	
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type	value consumer: $\Sigma \rightarrow \mathbf{out}$ cr in rc Unit
Σ Choice == inq ord acc ret pay cla ign	$\operatorname{consumer}(\sigma) \equiv$
CR == Inq() Ord() Acc() Pay() Cla() Ign()	c0 (let cho == inq $\lceil \operatorname{ord} \rceil$ acc $\lceil \operatorname{ret} \rceil$ pay $\lceil \operatorname{cla} \rceil$ ign in c1 let $\sigma' =$
RC == Ofr() Del() Inv()	c2 case cho of a^3 in a^3 let $(\pi'') = a^3$ in a^3 and
channel cr:CR, rc:RC	c3 inq \rightarrow let (σ'' ,i) = in cr!i; σ'' end c4 ord \rightarrow let order = in cr!order end
	c5 $\operatorname{acc} \to \operatorname{if} \operatorname{then} \operatorname{let} (\sigma'', \operatorname{a}) \operatorname{in} \operatorname{crla} ; \sigma'' \operatorname{end} \operatorname{else} \sigma \operatorname{end}$ c6 $\operatorname{ret} \to \operatorname{if} \operatorname{then} \operatorname{let} (\sigma'', r) = \operatorname{in} \operatorname{crlr} ; \sigma'' \operatorname{end} \operatorname{else} \sigma \operatorname{end}$
	c7 pay \rightarrow if then let $(\sigma'', \mathbf{p}) =$ in cr!c; σ'' end else σ end
	c8 cla \rightarrow if then let $(\sigma'', c) =$ in cr!c; σ'' end else σ end c9 ign $\rightarrow \sigma$
	c10 end c11 consumer(σ') end end)
	(11 consumer(o) end end)
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[] /]	• We narrate in detail the informal points (i–vii) above.
s1 (let $res = rc$? in s2 let $\sigma' =$	• The consumer function has two internally nondeterministically chosen alternatives.
s3 case res of	\star Either the initiative is on the side of the consumer (i.e., 'client'
s4 Ofr() \rightarrow handle_ofr(res)(σ), s5 Del() \rightarrow handle_del(res)(σ),	mode, shown using "c" prefixed line labels);
so $\text{Del}() \rightarrow \text{handle_del(res)}(\sigma),$ so $\text{Inv}() \rightarrow \text{handle_inv}(\text{inv})(\sigma),$	\star or the consumer "passively" awaits response from the retailer
$s7 \qquad \dots \rightarrow \dots$	(i.e., 'server' mode, shown using "s" prefixed line labels).
s8 end in s9 consumer(σ') end end)	
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oll/Jah11/Jah11-vii Apel 5, 2006, 09:35 Page 1245, Topic: 42, Feit: 14 Richard Piersen Plank, DK-2019 Hg-Leight, Dennak	Internal April 5, 2006, 69:15 Page 1246, Topic: 42, Foil: 15 Richard Processes Paid, 04:308 Kgi Lingde, Dessard
 (c) As a client the consumer nondeterministically internally, i.e., of her own free / will, chooses between doing any of the actions 	• (s) As a server the consumer
\star (c3) inquire about merchandise,	 ★ awaits a response from the retailer. ★ If none is forthcoming, the consumer "deadlocks"!
\star (c4) order merchandise ,	\star If a response is forthcoming, it is either
 * (c5) accept delivery of merchandise believed to have been delivered , * (c6) return merchandise believed to have been delivered, 	◊ (s4) an offer, possibly prompted by an earlier consumer inquiry — but not necessarily. It could be an "own initiative" by the retailer, or
\star (co) return merchandise believed to have been denvered, \star (c7) pay for merchandise believed to have been delivered,	\diamond (s5) a delivery (etc.),
\star (c8) claim refund on supposedly faulty merchandise believed to have been	\diamond (s6) an invoice (etc.),
delivered, or * (c9) ignore whatever goes on!	\diamond (s7) or other! \star In any case, a new state (s2) results.
 Any of these actions (the last is, in effect, a nonaction) does, indeed, leave a side 	• The consumer resumes being a consumer in a new state resulting from either her
effect, a remembrance, in the mind of the consumer, hence a state change, from	own initiatives, or from externally prompted actions (c11), resp. (s9).
state to state' ((c1)).	•
220, Fac: +45 4993 0074 (c) Direct Bigener, Findung 131, DK-2040 Helter, Dewnack E-enaile: deditions:dou.de, bigener@genail.com, direct@genail.com, direct@genail.com, direct@genail.com, direct@genail.com	+46 455 1703, Fax +46 483 05% (2). Dates Eigener, Frederij 11, 054 2968 148th, Dennak Ernalis de Benna fas de Spiner Byzal Lone, dateRhipmer Jair UKL sons inn dat

¹⁴We tacitly assume that such a concept as "free will" exists in connection with consumer behaviour!

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Constant Const	home/db/vill/2kh11/3kh11-vi April 5, 2006, 00-35 Page 1248, Topic - 42, Foil: 17 Robust Page 104 page 100 pag
• In the above example we are deliberately leaving many things	Example 11.152 Shopping — Detailed Consumer Behaviour:
unspecified ().The point is that we are not so much interested — in this section	We left some open points in the earlier example.We shall use these to illustrate other aspects of human behaviour, its informal
in those () things.We are interested in modelling, in describing, the vagaries of	and formal descriptions.We start by singling out the treatment of a consumer-initiated initiative, like
• We are interested in modeling, in describing, the vagaries of consumers.	making an inquiry (c3). c3 inq \rightarrow let (σ'' ,i) = in cr!i ; σ'' end
• These uncertainties, these unpredictable wanderings, were fully described by the nondeterministic choice	 To (c3) we add the "missing" information about how we form (i.e., "compute")
• and by the fact that after the outputs (!) the consumer "recursed" being a consumer without awaiting responses from the retailer.	the information (i.e., data) that goes into an inquiry. c3 inq \rightarrow let (σ'' ,i) = mki(σ) in cr!i ; σ'' end
• It was also shown in our not defining, yet, the handle_xyz()	and
clauses.	$\frac{\text{value}}{\text{mki: } \Sigma \to \text{Ing } \Sigma}$
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• In the formula above we have referred to the action of human	\bullet We leave the description of mki open.
"gathering" the information that goes into an inquiry by the cryptic function name mki .	• Leaving it open also leaves it open to interpretation.
• To make an inquiry we assume that the consumer refers to	• Anything is allowed that forms an inquiry and possibly changes the state.
whatever sense impressions that person may have, and we model that ("whatever sense impressions that person may have") as part	• This "openness" models the vagaries of human behaviour.
of that person's state.Hence the gathering action operates on the state and updates it	• The case for all other consumer-initiated actions directed at the retailer is similar to that of the inquiry action in respect of acting
with the fact that the person (whose state it is) has contemplated	upon and communicating information.
and formed an inquiry.	
5 120, Fac + 6 618 804 🛞 Dine Bjører, Frederij 11, DK 200 Hilde, Denask Evenik delfensdeude, bjører Gjørelgenstan, divelkjorer bij, UK, sewirer div. df. Di	- 16 605 120, Da: +6 603 501 🔅 Daie Bjener, Feducij 1, DK-308 Hate, Damask E-mail: dellom Au, du bjenerdynal can, dostbjenerala (191, une inn d
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 We now treat the case of retailer-initiated interactions. Let us consider the consumer's reaction to a retailer offer response. 	 No further action is described. In particular the perhaps arrested reaction of the consumer "immediately fining.
• Let us consider the consumer's reaction to a retainer oner response. s4 $Ofr() \rightarrow handle_ofr(res)(\sigma)$	• In particular, the perhaps expected reaction of the consumer "immediately firing off" an order, or a declination of the offer is not described.
	• Any such possible reaction is modelled by the
• We refer to this reaction by handle_ofr.	\star internal nondeterministic choices of the \star client actions of the consumer:
 As for the making of an inquiry (etc.), this action is not being further described, other than saying: 	* The consumer may, sooner or later or even never
\star It is any action that somehow records,	₩ 7
× it is any action that bonnenow records,	\star select or choose an order reply.
 ★ in the consumer's state, i.e., mind, or jotted down on a piece of paper, 	\star And that order reply may relate, "through" the mko action (c4, not shown),
 ★ in the consumer's state, i.e., mind, or jotted down on a piece of paper, ★ say stuck to a kitchen notice board, 	
 * in the consumer's state, i.e., mind, or jotted down on a piece of paper, * say stuck to a kitchen notice board, * the fact that approximately "such and such" an offer was received. 	\star And that order reply may relate, "through" the mko action (c4, not shown),
 ★ in the consumer's state, i.e., mind, or jotted down on a piece of paper, ★ say stuck to a kitchen notice board, 	\star And that order reply may relate, "through" the mko action (c4, not shown),
 ★ in the consumer's state, i.e., mind, or jotted down on a piece of paper, ★ say stuck to a kitchen notice board, ★ the fact that approximately "such and such" an offer was received. value handle_ofr: Ofr → Σ → Σ 	 ★ And that order reply may relate, "through" the mko action (c4, not shown), ★ to the Offer response (s4).
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* in the consumer's state, i.e., mind, or jotted down on a piece of paper, * say stuck to a kitchen notice board, * the fact that approximately "such and such" an offer was received. value handle_ofr: $Ofr \rightarrow \Sigma \rightarrow \Sigma$ Tex re 100 20 20 20 20 20 20 20 20 20 20 20 20 2	* And that order reply may relate, "through" the mko action (c4, not shown), * to the Offer response (s4). • * * * * * * * * * * * * * * * * * * *
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 * in the consumer's state, i.e., mind, or jotted down on a piece of paper, * say stuck to a kitchen notice board, * the fact that approximately "such and such" an offer was received. value handle_off: Ofr → Σ → Σ value value<	* And that order reply may relate, "through" the mko action (c4, not shown), * to the Offer response (s4). OPTIMEE ENGINEENCE. Consummer and Schwer Delge (s4). OPTIMEE ENG
 * in the consumer's state, i.e., mind, or jotted down on a piece of paper, * say stuck to a kitchen notice board, * the fact that approximately "such and such" an offer was received. value handle_off: Ofr → Σ → Σ vare and the state approximately approximately "such and such" an offer was received. value handle_off: Ofr → Σ → Σ vare and the state approximately approxim	* And that order reply may relate, "through" the mko action (c4, not shown), * to the Offer response (s4).
 * in the consumer's state, i.e., mind, or jotted down on a piece of paper, * say stuck to a kitchen notice board, * the fact that approximately "such and such" an offer was received. value handle_off: Ofr → Σ → Σ (20.00 Meet class 10.00 Meet (10.00 Meet) (20.00 Meet class 10.00 Meet) (20.00 Meet) (20.00	* And that order reply may relate, "through" the mko action (c4, not shown), * to the Offer response (s4). OPTIMEE ENGINEENCE. Consummer and Schwer Delge (s4). OPTIMEE ENG

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Techniques 50 Human Behaviour:	Techniques 51 Human Behaviour (III):
 (II) Alternatively we can model human behaviour by the arbitrary selection of elements from sets and of subsets of sets: 	 Commensurate with the above, humans interpret rules and regulations differently,
Conceptual Model of Human Behaviour, II	• and not always "consistently" — in the sense of repeatedly applying the same interpretations.
	• Our final specification pattern is therefore:
type X	type
value $ V_{i} = V_{i} $	Action = $\Theta \xrightarrow{\sim} \Theta$ -infset value
hb.i: X-set \rightarrow , hb.i(xs,) \equiv let x:X · x \in xs in end hb.j: X-set \rightarrow , hb.j(xs,) \equiv let xs:X-set · xs' \subseteq xs in end	hum.int: Rule $\rightarrow \Theta \rightarrow \text{RUL-infset}$ action: Stimulus $\rightarrow \Theta \rightarrow \Theta$
	hum_beha: Stimulus × Rules → Action → $\Theta \xrightarrow{\sim} \Theta$ -infset hum_beha(sy_sti,sy_zul)(α)(θ) as θ set
 The above shows just fragments of formal descriptions of those parts which reflect human behaviour. 	$post \\ \theta set = \alpha(\theta) \land action(sy_sti)(\theta) \in \theta set$
• Similar, loose descriptions are used when describing faulty supporting technologies, or the	$\land \forall \theta':\Theta \cdot \theta' \in \Theta$ set \Rightarrow \exists se_rul:RUL-se_rul \in hum_int(sy_rul)(θ) \Rightarrow se_rul(θ, θ')
"uncertainties" of the intrinsic world	
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• The above is, necessarily, sketchy:	• The above-stated axioms express how it is in the domain,
* There is a possibly infinite variety of ways of interpreting some rules.	• not how we would like it to be.
* A human, in carrying out an action, interprets applicable rules and chooses one which that person believes suits some (professional, sloppy, delinquent or	• For that we have to establish requirements.
criminal) intent.	• This is the subject of late lectures.
\star "Suits" means that it satisfies the intent,	v
♦ i.e., yields true on the pre/post-configuration pair, • when the action is a sefermed.	
 ♦ when the action is performed — ♦ whether as intended by the ones who issued the rules and regulations or 	
not.	
\star We do not cover the case of whether an appropriate regulation is applied or	
not	
•	
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Human Behaviour and Knowledge Engineering	 Knowledge engineering is thus concerned with understanding relations between two or more agents' knowledge (etcetera) about one another with respect to the
• Domain engineering aims at making precise our understanding of the entities,	following issues:
functions, events and behaviours of the observable phenomena and the	\star what does an agent know about what another agent knows or believes;
intellectual concepts of the domain.	\star which (things) does an agent promise another agent who may then commit or
 By knowledge we shall, in the narrow context of knowledge engineering, understand that which a human (or a machine, i.e., an agent) knows or believes 	promise other or similar things to yet other agents; * and so on.
or assumes or commits with respect to (knowledge, beliefs, promises or	 The subject of knowledge engineering is of importance when we model human
commitments of) another agent.	• The subject of knowledge engineering is of importance when we model numan behaviour
• By knowledge engineering we shall understand the formulation (whether	• but we shall not in this book venture into this very important field of computer
informal or formal) of such knowledge.	and computing science.
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Discussion	Reminder /
• Please observe the difference between the version of meaning under	We remind the reader of the principle stated at the outset of this
the rules and regulations facet, and the present version.	lecture on domain human behaviour:
\star The former reflected the semantics as intended by the	Principles 11.71 Describing the Domain Human Behaviour
stakeholder who issued the rules and regulations.	Facets: When describing a domain,
\star The latter reflects the professional or the sloppy or the delinquent	\bullet analyse it with respect to its human behaviour phenomena and
or the criminal semantics as intended by the similarly "qualified"	concepts.
staff which carries out the rule-abiding or rule-violating actions.	
	• Focus on possibly describing these separately.
• Please also observe that we do not here exemplify any regulations.	Focus on possibly describing these separately.Make sure that descriptions of other described domain facets are
	• Make sure that descriptions of other described domain facets are commensurate with possibly multiple, alternative descriptions of
	• Make sure that descriptions of other described domain facets are
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	• Make sure that descriptions of other described domain facets are commensurate with possibly multiple, alternative descriptions of

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Topic 43	• The domain facets that we have covered included:
Other Domain Facets?	* intrinsics.
	\star support technologies,
• We have exemplified and formalised some aspects of human	* management and organisation,
behaviour in the domain.	✓ intalligeneric and organisation,✓ rules and regulations,
• And we have informally and formally described how we model	* domain scripts and
some aspects of some facets (rules and regulations, respectively	* human behaviour.
human behaviour).	* numan behaviour.
• The latter form some initial contributions to a more proper theory	
of what we mean by domain facets.	
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Other Domain Facts? Intra-tributanti and Methandica Medining ## n/db/voll1/3ch11/3ch11-3iii April 5, 2006, 09:35 Page 1265, Topic: 43, Foll 3 Rickat Powersking Colorado Kajulugin Dewark	19 Other Domain Facets? beland a Minuteatical Multileg
• The substitute new is obvious:	Dringinle 11 79 Demoin Frants
• The question now is obvious:	Principle 11.72 Domain Facets:
\star Are there other domain facets?	• When modelling, informally or formally, a domain,
• We refrain, at present, from an answer.	\bullet analyse the domain phenomena with respect to whether
• But we would be surprised if there were not!	• one or another, or a combination of currently identified
• In other words, we expect further practice and further exploratory	• domain facets suffice to model the domain, or
• In other words, we expect further practice and further exploratory and experimental research to yield additional facets.	
• Thus the course student should be on the look out for whether the	• whether you, the developer, have to discover, i.e.,
• I hus the course student should be on the look out for whether the facets covered here suffice.	• identify, define and otherwise find a suitable set of one or more
	principles, techniques and tools
• More generally we must accept the next principle:	\bullet with which to model the domain
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Comparison of Domain Models Initial at Homoday Initial Agent 5, 2005, 69:35 Page 1287, Tepic 44, Feb 1 Richard Person Pade 04/30 (q.L.r.pd) Downad	11.0.1.1 General Initial a Usinoing and REMARKAD Linking Testical a Usinoing and REMARKAD Linking Testical a Usinoing and REMARKAD Linking home/ds/vell1/2kh11/2kh11-vii April 5, 2006, 60:35 Page 1288, Topic: 44, Foil: 2
Topic 44	Collating Domain Facet Descriptions
Composition of Domain Models	General
composition of Domain Woucis	
• From the various facet descriptions the domain engineer	• The various domain facets can be described more or less individually.
• now has to weave a fabric, and Sect. is about that.	 It is a good idea to try identify and describe these separate facets individually — in other words applying the principle of separate concerns.
• The domain engineer may also have to formalise the full	
description, and Sect. is about that.	 But, in doing so the describer may be repeating some descriptive material unnecessarily.
description, and seet. is about that.	\star Such duplicate material may differ in details and may thus create
	inconsistencies as well as doubts in the minds of the readers.
	• But analysing the domain and describing it on a per facet basis may yield insight
	and lead to
	\star discoveries about the domain not otherwise attainable.
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	From Big Lies via Smaller Lies to the Truth
A Comprehensive Narrative	from Eig Eics via Smaller Eics to the frach
·	A Golden Rule of Comprehension Develop your domain understanding — and hence
• Describing the domain on a per facet basis may lead to a	A Golden Rule of Comprehension Develop your domain understanding — and hence the first round of domain descriptions — by analysing and describing the domain
• Describing the domain on a per facet basis may lead to a fragmented, staccato (abrupt, disjointed) description.	A Golden Rule of Comprehension Develop your domain understanding — and hence the first round of domain descriptions — by analysing and describing the domain facet-by-facet (including formalisation), then by consolidating this into a more
 Describing the domain on a per facet basis may lead to a fragmented, staccato (abrupt, disjointed) description. To avoid this it may be a good idea to take all the bits and pieces 	A Golden Rule of Comprehension Develop your domain understanding — and hence the first round of domain descriptions — by analysing and describing the domain
 Describing the domain on a per facet basis may lead to a fragmented, staccato (abrupt, disjointed) description. To avoid this it may be a good idea to take all the bits and pieces of the various facet descriptions and write them into one whole 	A Golden Rule of Comprehension Develop your domain understanding — and hence the first round of domain descriptions — by analysing and describing the domain facet-by-facet (including formalisation), then by consolidating this into a more
 Describing the domain on a per facet basis may lead to a fragmented, staccato (abrupt, disjointed) description. To avoid this it may be a good idea to take all the bits and pieces 	A Golden Rule of Comprehension Develop your domain understanding — and hence the first round of domain descriptions — by analysing and describing the domain facet-by-facet (including formalisation), then by consolidating this into a more
 Describing the domain on a per facet basis may lead to a fragmented, staccato (abrupt, disjointed) description. To avoid this it may be a good idea to take all the bits and pieces of the various facet descriptions and write them into one whole comprehensive narrative. In merging the various facets into one structured narrative the 	A Golden Rule of Comprehension Develop your domain understanding — and hence the first round of domain descriptions — by analysing and describing the domain facet-by-facet (including formalisation), then by consolidating this into a more
 Describing the domain on a per facet basis may lead to a fragmented, staccato (abrupt, disjointed) description. To avoid this it may be a good idea to take all the bits and pieces of the various facet descriptions and write them into one whole comprehensive narrative. In merging the various facets into one structured narrative the domain engineer may discover possible inconsistencies — and thus 	A Golden Rule of Comprehension Develop your domain understanding — and hence the first round of domain descriptions — by analysing and describing the domain facet-by-facet (including formalisation), then by consolidating this into a more
 Describing the domain on a per facet basis may lead to a fragmented, staccato (abrupt, disjointed) description. To avoid this it may be a good idea to take all the bits and pieces of the various facet descriptions and write them into one whole comprehensive narrative. In merging the various facets into one structured narrative the 	A Golden Rule of Comprehension Develop your domain understanding — and hence the first round of domain descriptions — by analysing and describing the domain facet-by-facet (including formalisation), then by consolidating this into a more
 Describing the domain on a per facet basis may lead to a fragmented, staccato (abrupt, disjointed) description. To avoid this it may be a good idea to take all the bits and pieces of the various facet descriptions and write them into one whole comprehensive narrative. In merging the various facets into one structured narrative the domain engineer may discover possible inconsistencies — and thus 	A Golden Rule of Comprehension Develop your domain understanding — and hence the first round of domain descriptions — by analysing and describing the domain facet-by-facet (including formalisation), then by consolidating this into a more
 Describing the domain on a per facet basis may lead to a fragmented, staccato (abrupt, disjointed) description. To avoid this it may be a good idea to take all the bits and pieces of the various facet descriptions and write them into one whole comprehensive narrative. In merging the various facets into one structured narrative the domain engineer may discover possible inconsistencies — and thus will have an early opportunity to correct such. The possibly revised (for example corrected) "bits and pieces" should not be thrown away. They can serve as possibly clarifying 	A Golden Rule of Comprehension Develop your domain understanding — and hence the first round of domain descriptions — by analysing and describing the domain facet-by-facet (including formalisation), then by consolidating this into a more
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¹⁵Pedagogical: of the art and science of teaching. Didactic: intended to convey instruction and information as well as pleasure and entertainment [?].

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1.1.3 From Big Lies via Smaller Lies to the Truth			Institute of Informatics and Mathematical Modelling Technical University of Denmark	Ħ	1.10.1.3 From Big Lies via Smaller Lies to the Truth
w/db/voll1/3ch11/3ch11-viii	April 5, 2006, 09:35	Page 1271, Topic: 44, Foil: 5	Richard Potersens Plads, DK-2000 Kgs.Lyngby, Denmark		home/db/voll/3ch11/3ch11-vii
as its accompa	ay of structuring a anying formalisation sequence of narra	ons, is to form	ve narrative, as well ılate the full	/	Principles 11.73 T To achieve a smooth, universe of discourse,
nanative as a	sequence of nama	UIVCS.			 start by narrating a s
v	e narratives preten wiously with some		entire domain,		 Proceed by adorning simplifications.
★ But steps o	f subsequent narra	atives enlarge u	upon the scope,		 In doing this you have is, that you do not have
\star choosing pe	edagogically furthe	r domain aspe	cts —		• Then go on to detail
\star be they of i	ntrinsic, of suppor	t technology, o	of management and		"accommodation prin
1 /	or of the nature of				 Finally you have added of the universe of disc
	chosen is determin tics and good peda		e writer judges is		Thus "the limit of all
\star Many such	orders are possible	э.			
• We can phrase	e this unfolding of	a narrative as	follows:		

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WARE ENGINEERING: Domains, Requirements and Sc 2 Technical Issues	ftware Design	Volume 3	Department of Computer Science and Engineering Institute of Informatics and Mathematical Modelling Technical University of Denmark	DTU
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	Technica	al Issues		_/

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4525 3720, Fax

- We saw the need for composing intrinsic descriptions from intrinsic description parts.
- We have now seen, in the lectures on domain facets, through its coverage of many facets, the need for composing from descriptions of separate facets of a domain a comprehensive and consistent description.
- We refer to the use, for example, of RSL's scheme facility.
 - \star Non-intrinsic facet schemes can be expressed by extending basic (e.g., intrinsic) schemes with additional types, values and axioms.
 - * The hiding facility of schemes can likewise be used to express different, but commensurate models.

t by narrating a su	itable lie, call it a big lie	e, a gross simplification	1.
	ne ("false") narration wi	th smaller lies, that is	, with less gross
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0	· ·	ons, i.e., tell tiny lies w	hile still adhering to the
0 0	5		
the limit of all t	he lies is the truth"		_
	ceed by adorning the plifications. Aloing this you have that you do not have en go on to detail the commodation prince ally you have addeed he universe of disco	ceed by adorning the ("false") narration wi plifications. loing this you have to accommodate it so th hat you do not have to change anything in en go on to detail the less gross simplificatic commodation principle". ally you have added so much detail that yo he universe of discourse as our truthful abs	doing this you have to accommodate it so that the smaller lies fit hat you do not have to change anything in your presentation, onl en go on to detail the less gross simplifications, i.e., tell tiny lies w