Montanuniversität Leoben

Management of an open pit mine – state of the art

Content

- Knowledge as a factor of production

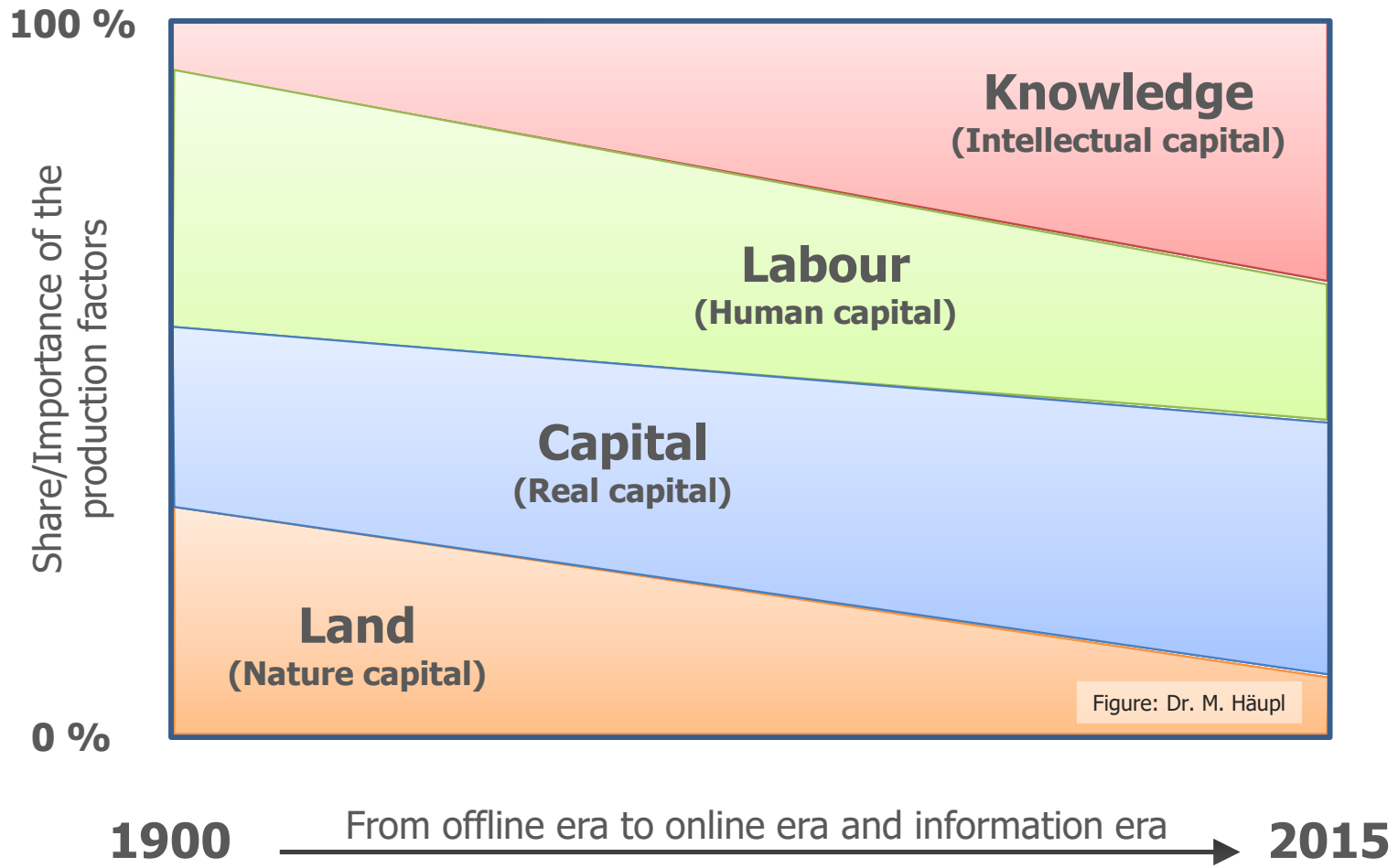
- Business processes – ressources to product
- Enterprise and operational organisation
- Data management and data analysis

- Automation of business processes

1 Knowledge as a factor of production

Knowledge - factor of production

Change of economic production factors



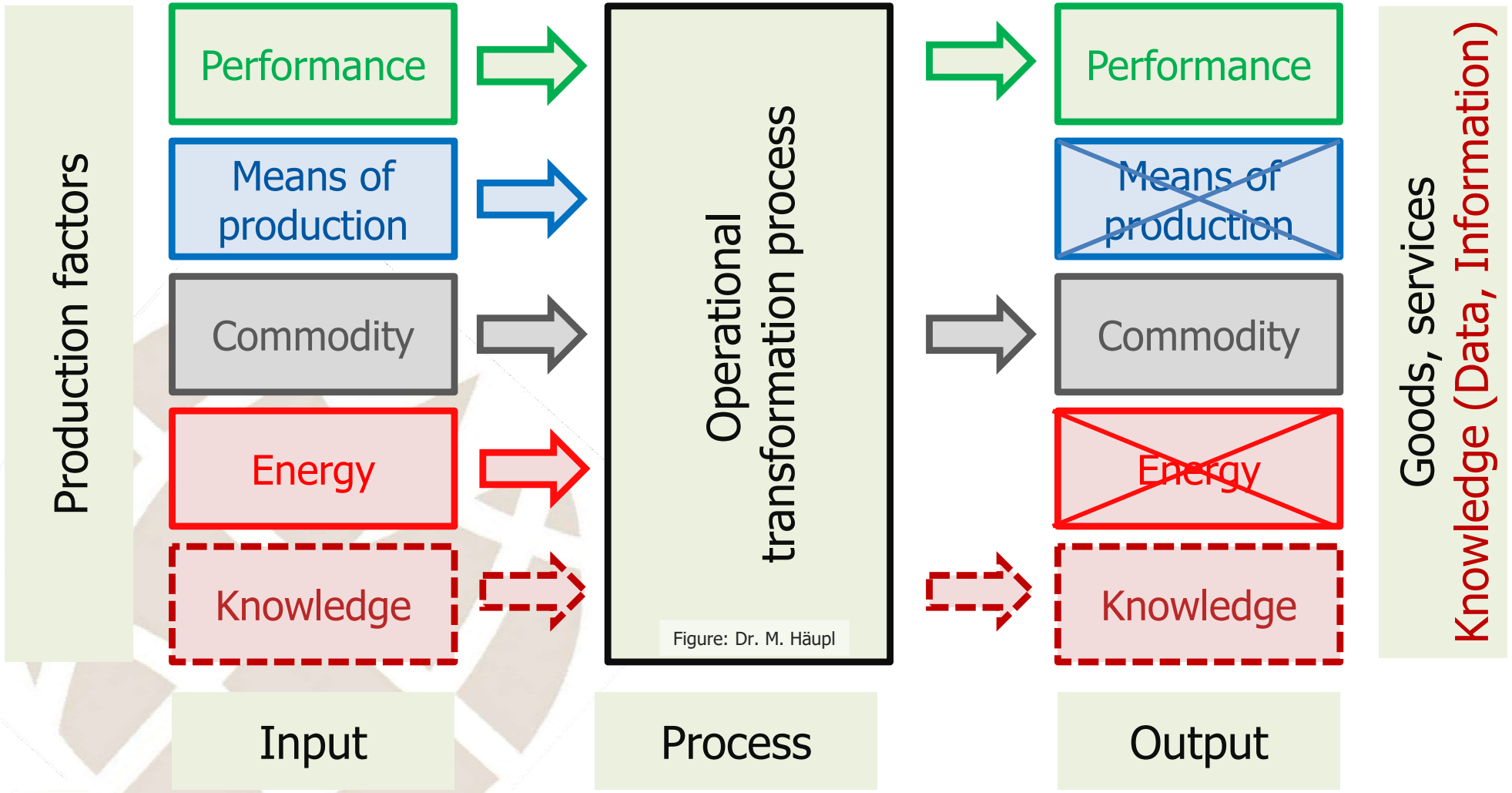
Knowledge - factor of production

Business economic production factors

- Performance (Work of human / + machine)
- Means of production (machinery, facility site, supplies)
- Commodity (= deposit + products)
- Energy (more and more important – CO_2)
- Knowledge (from data, then information)

Knowledge within the production process

Combination of production factors → Business processes



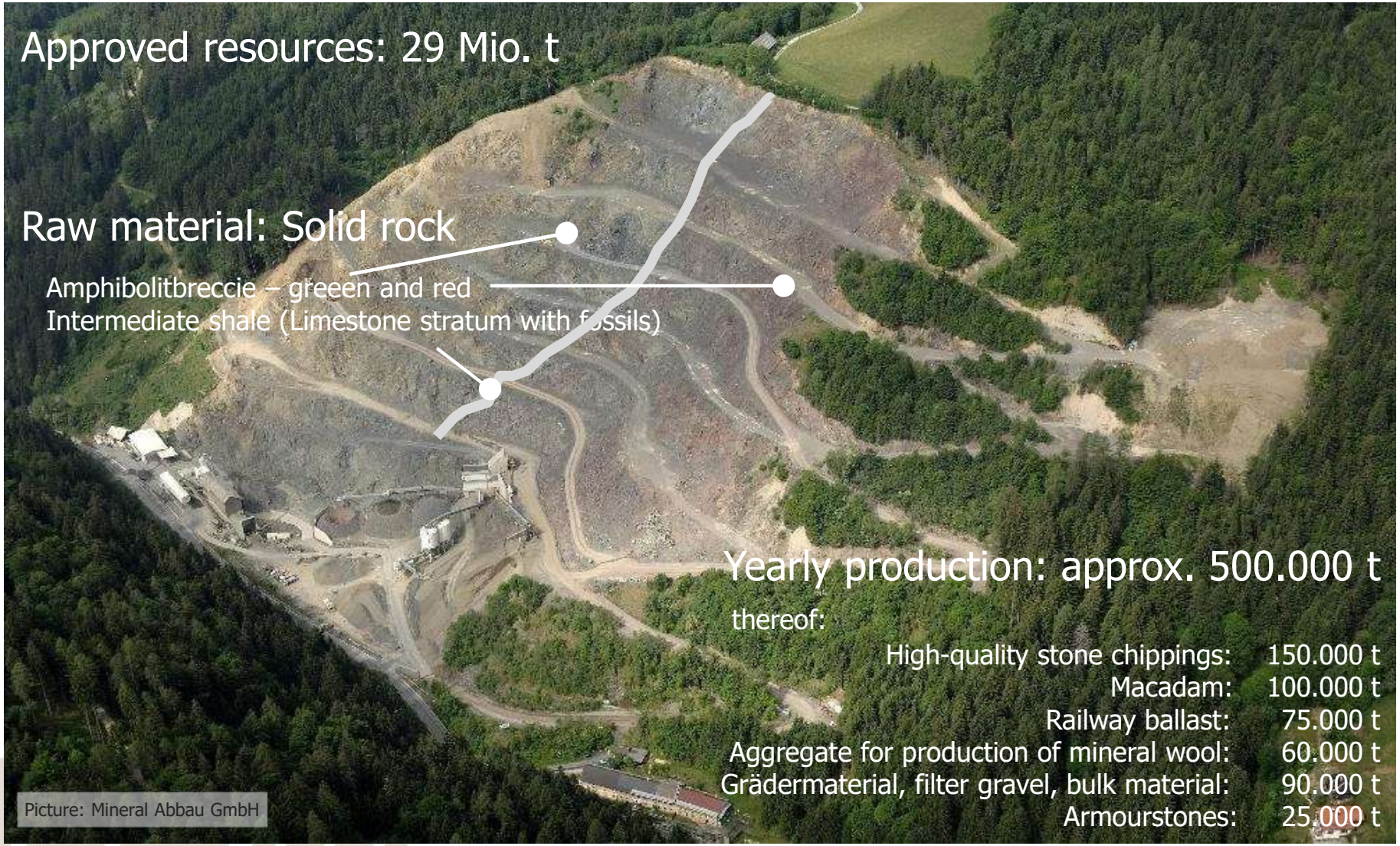
2
Business processes from resources to product

Processes: Preliminary inventory

Raw material and production plant: Operating company & site information

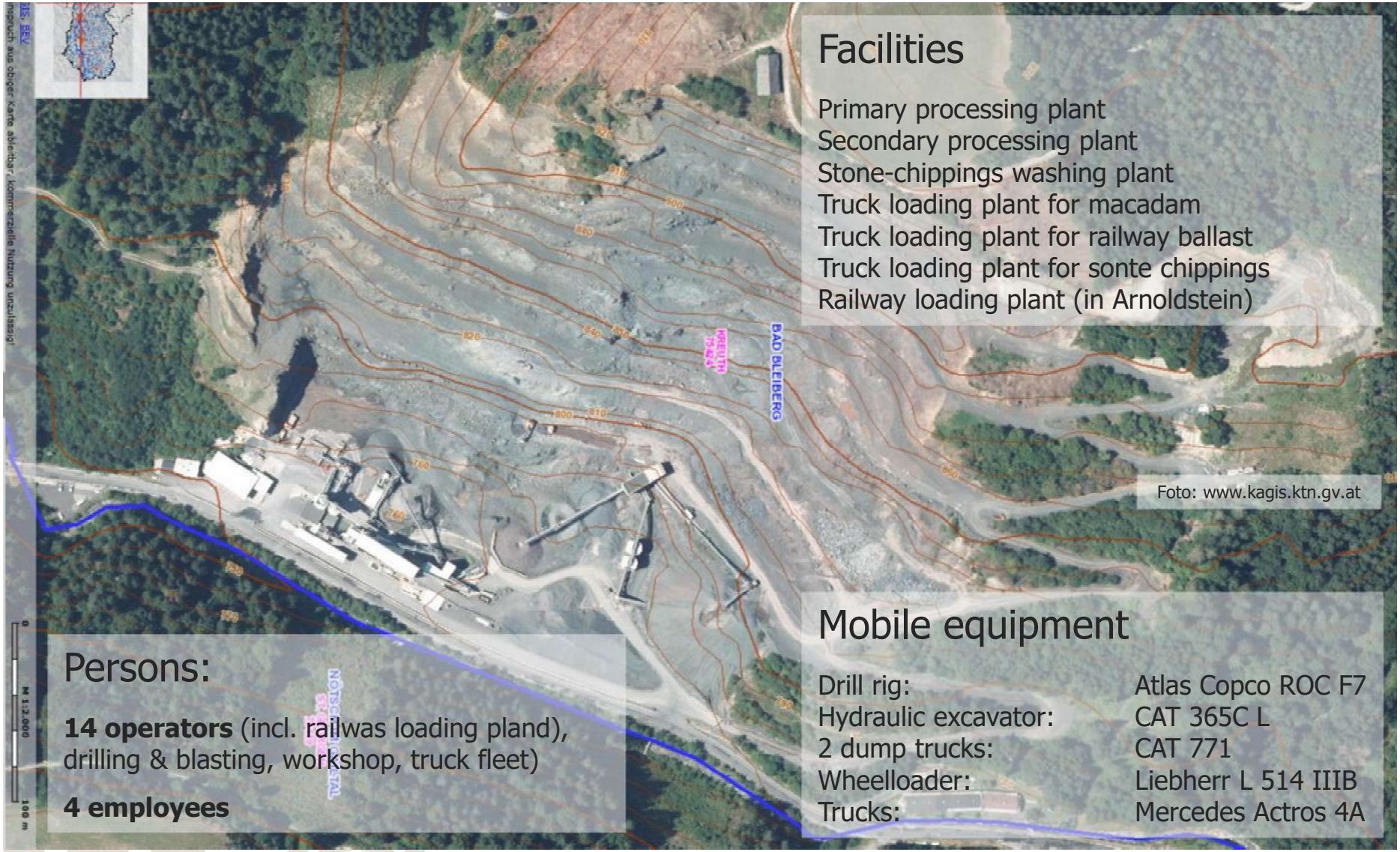
Processes: Preliminary inventory

Raw material and production plant: Resources & Products



Processes: Preliminary inventory

Raw material and production plant: Persons, mobile units & facilities



Processes: Structuring

Business processes: Typical description

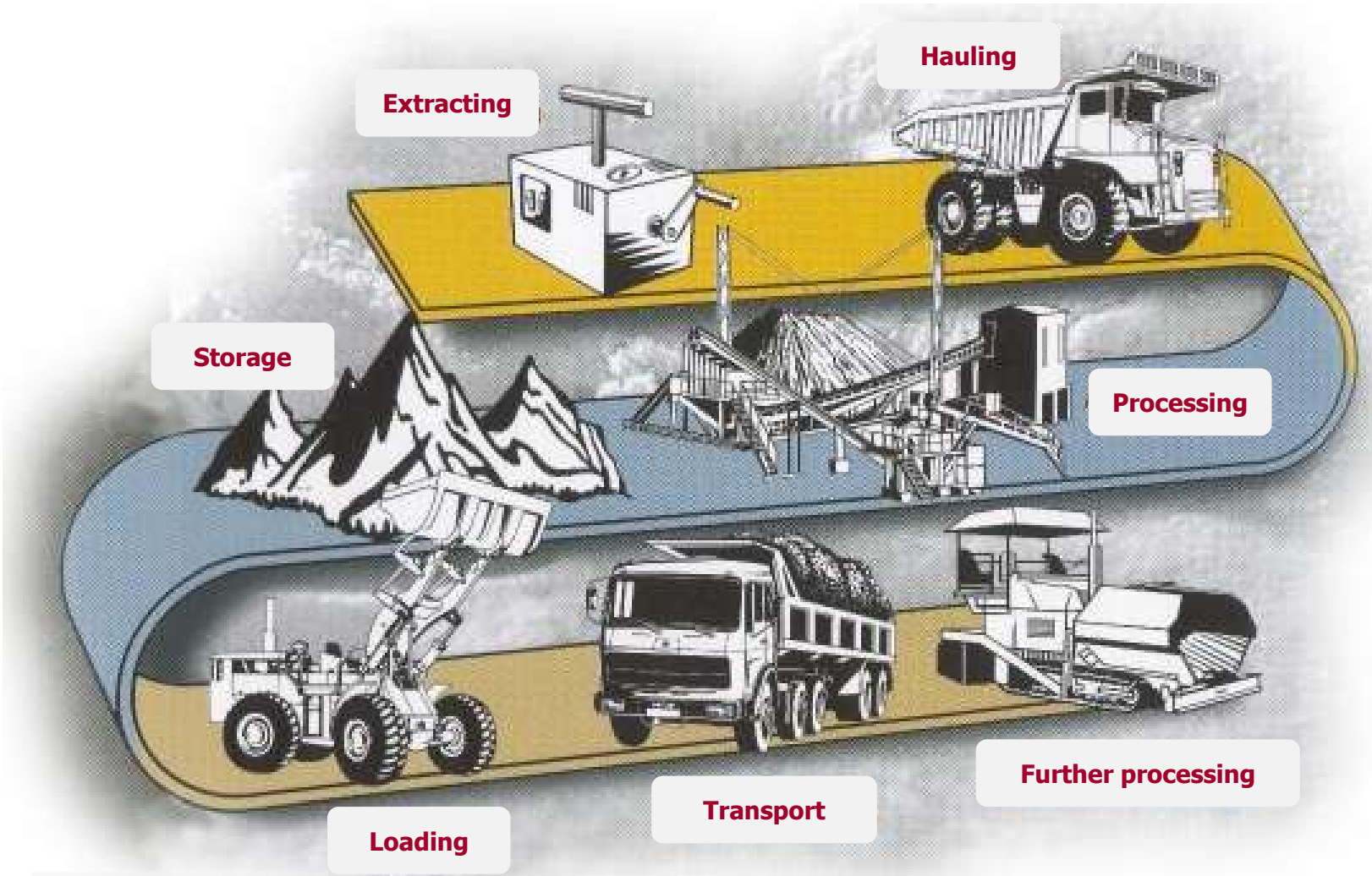


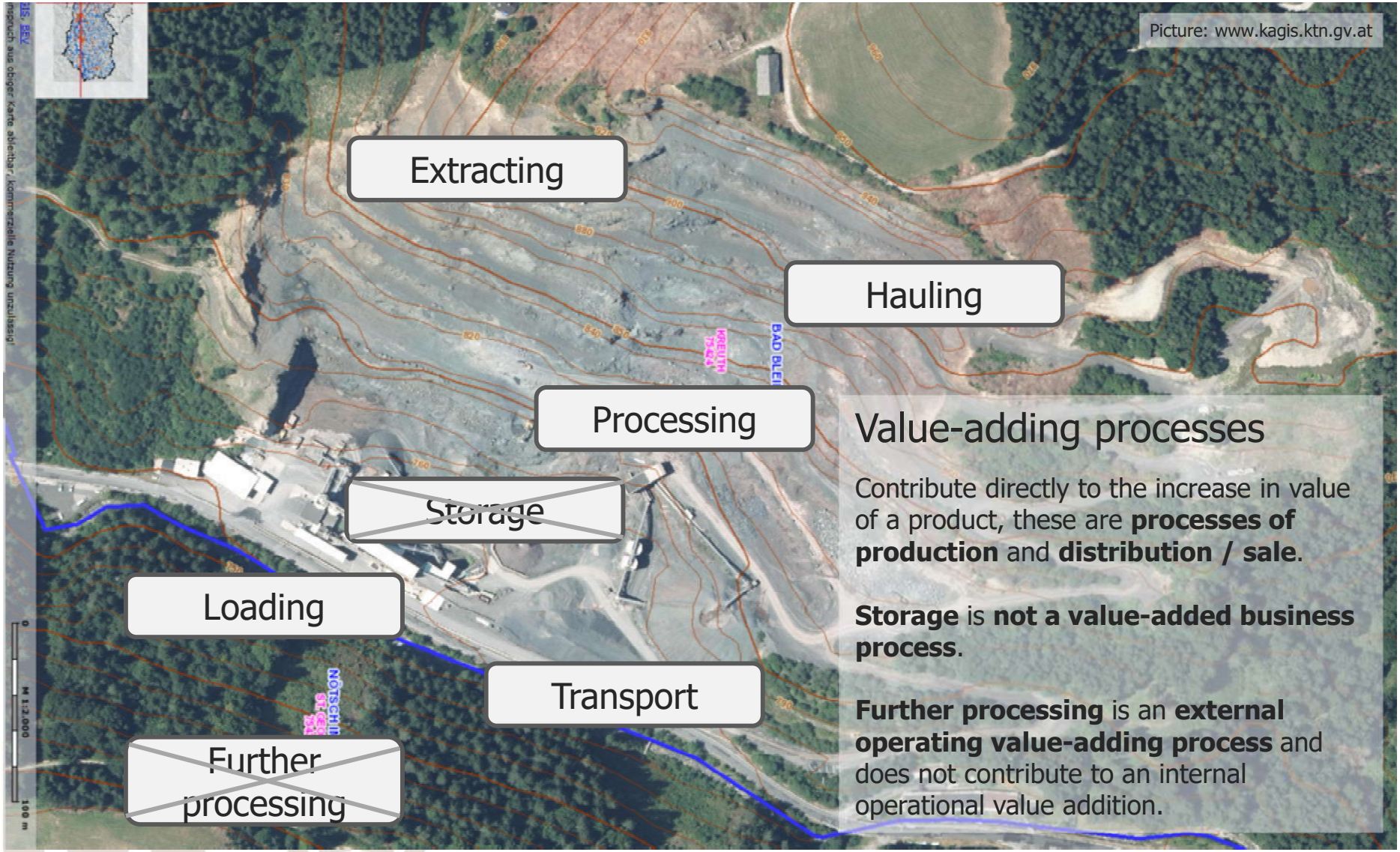
Figure: Forum Rohstoffe

Processes

- Extracting
- Hauling
- Processing
- Storage
- Loading
- Transport
- Further processing

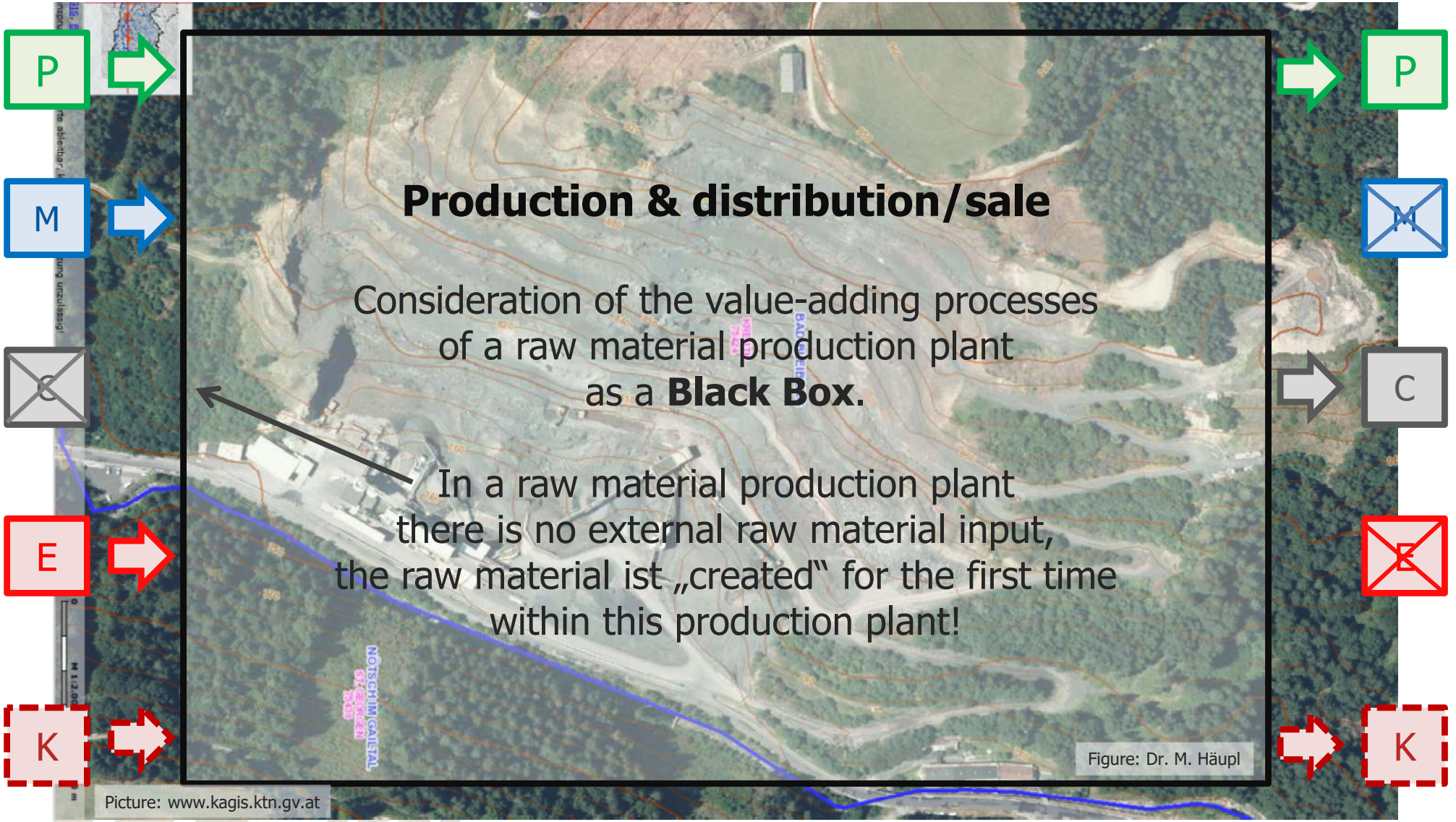
Prozesse: Strukturierung

Business processes: Processes in real operation



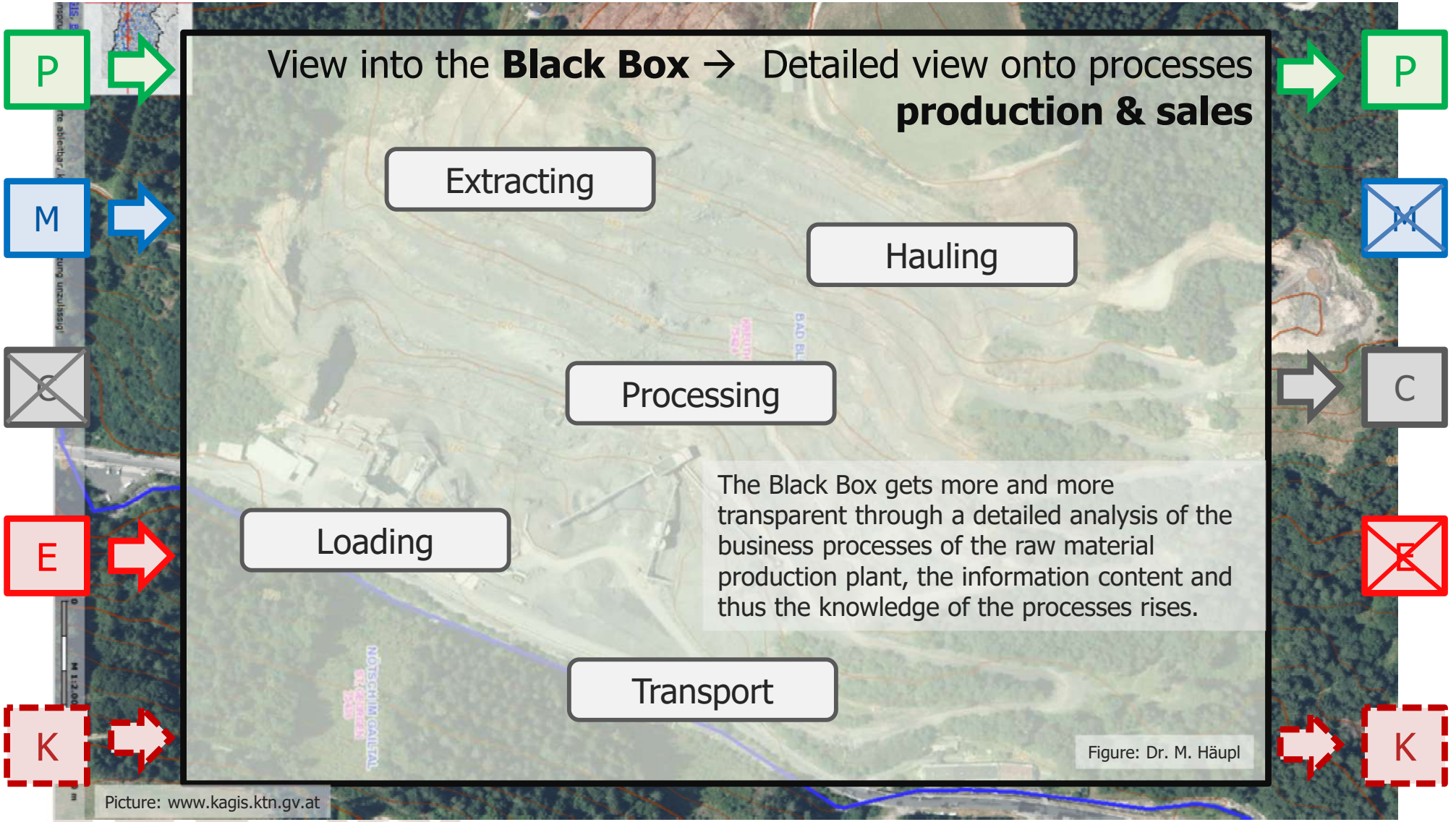
Processes: Structuring

Business processes: Value-adding processes & production factors



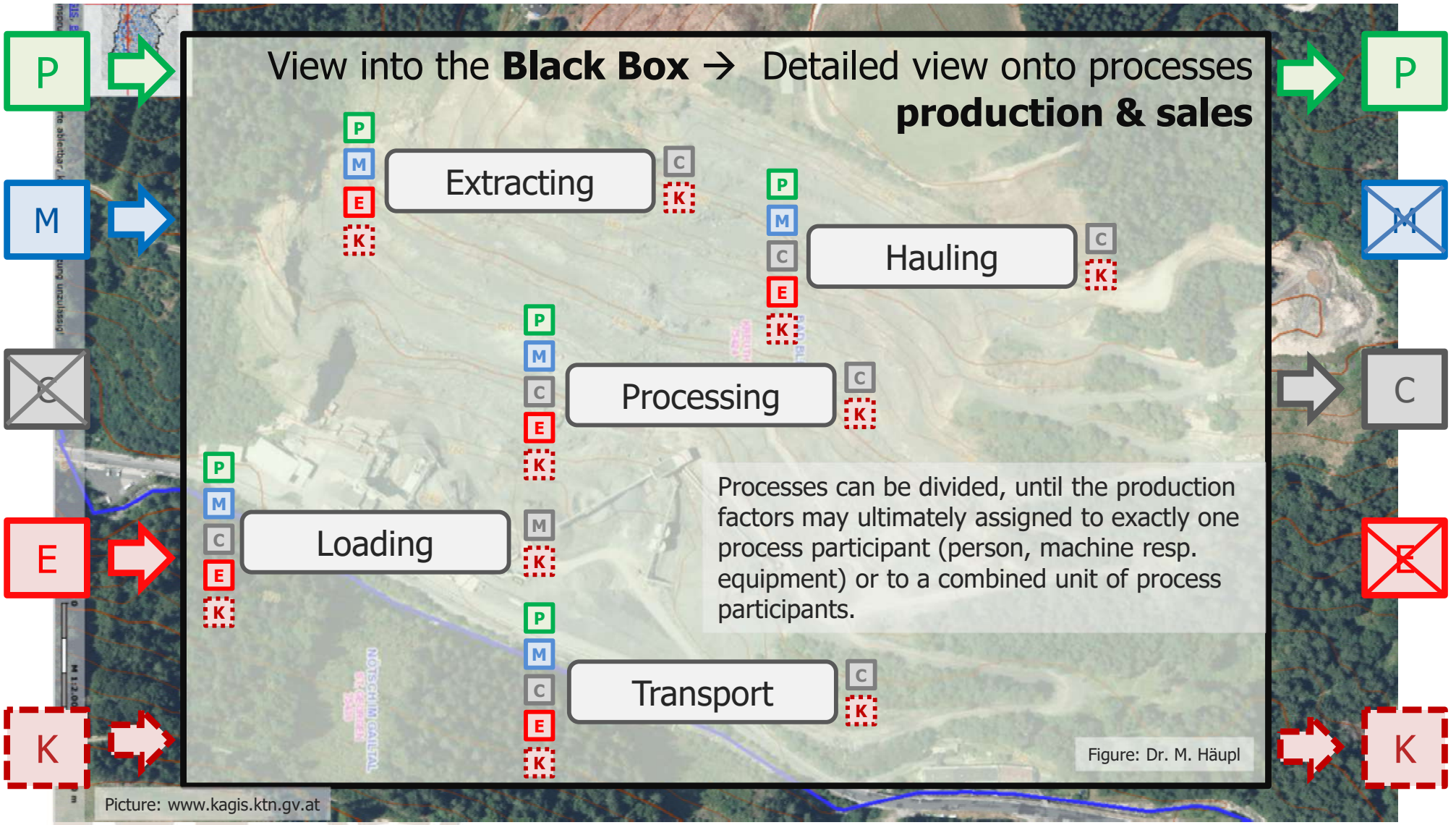
Processes: Structuring

Business processes: Value-adding processes & production factors



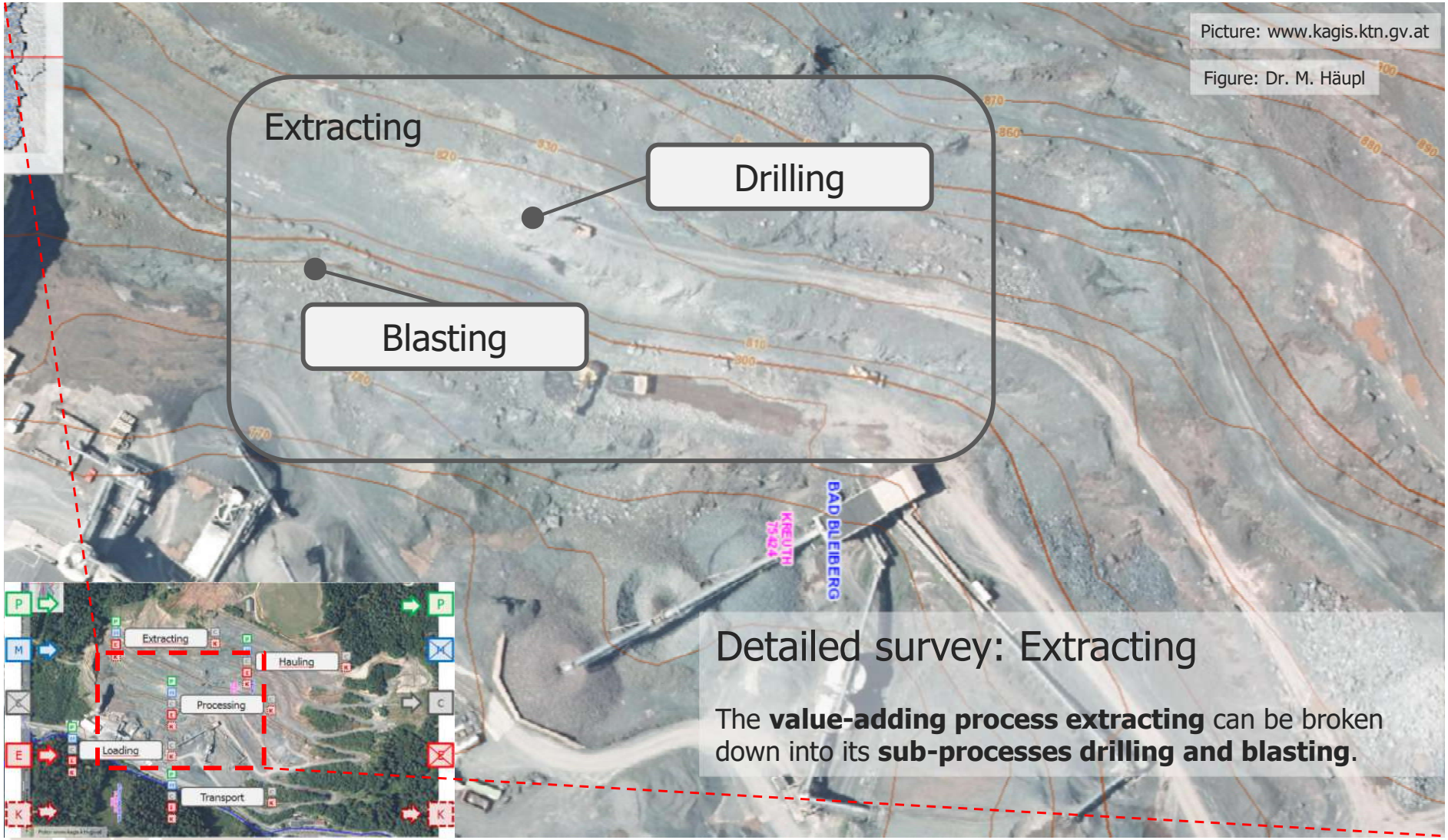
Processes: Structuring

Business processes: Value-adding processes & production factors



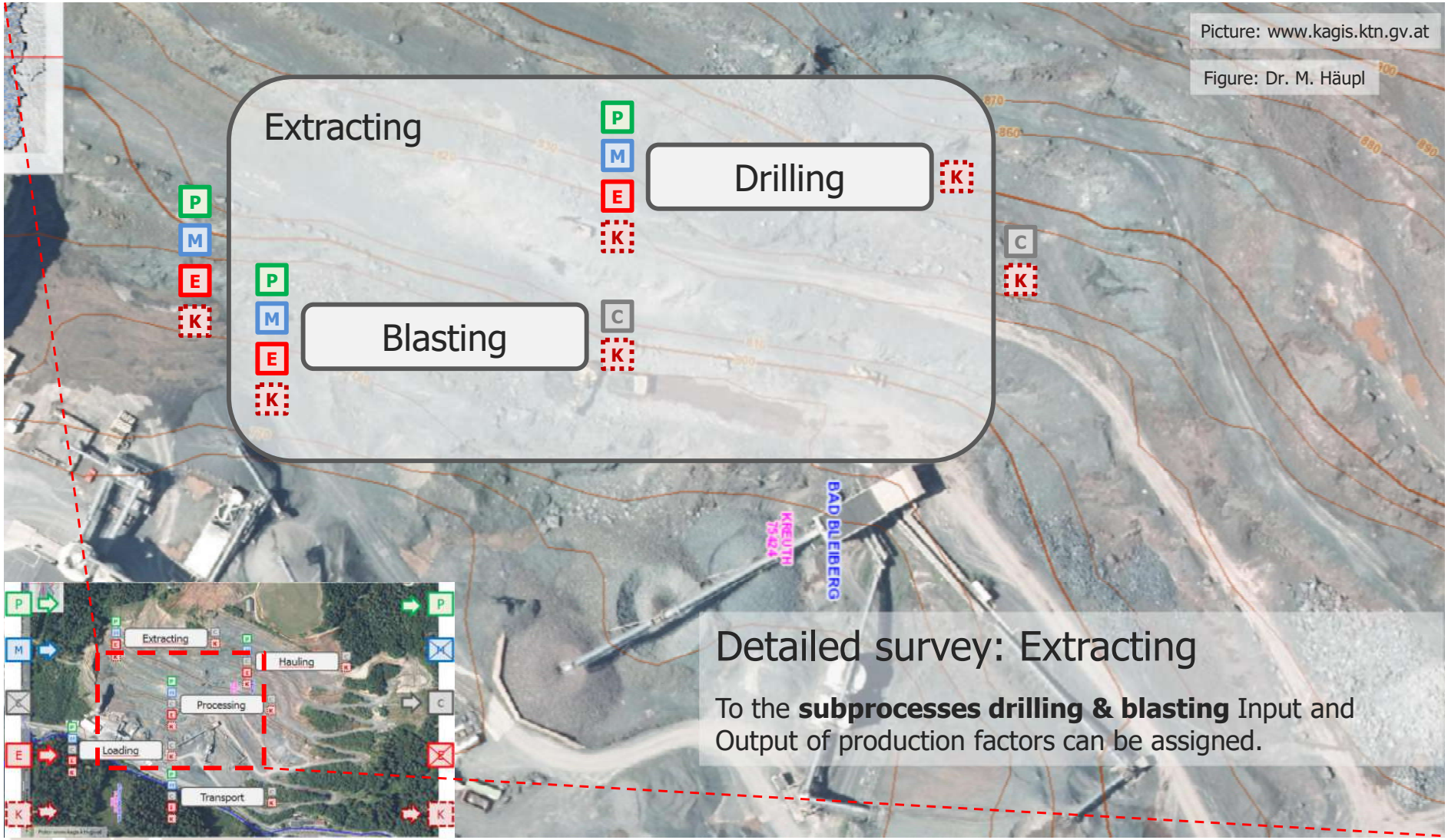
Processes: Structuring

Business processes: Value-adding processes & production factors



Processes: Structuring

Business processes: Value-adding processes & production factors



Processes: Structuring

Business processes: Sub processes and production factors

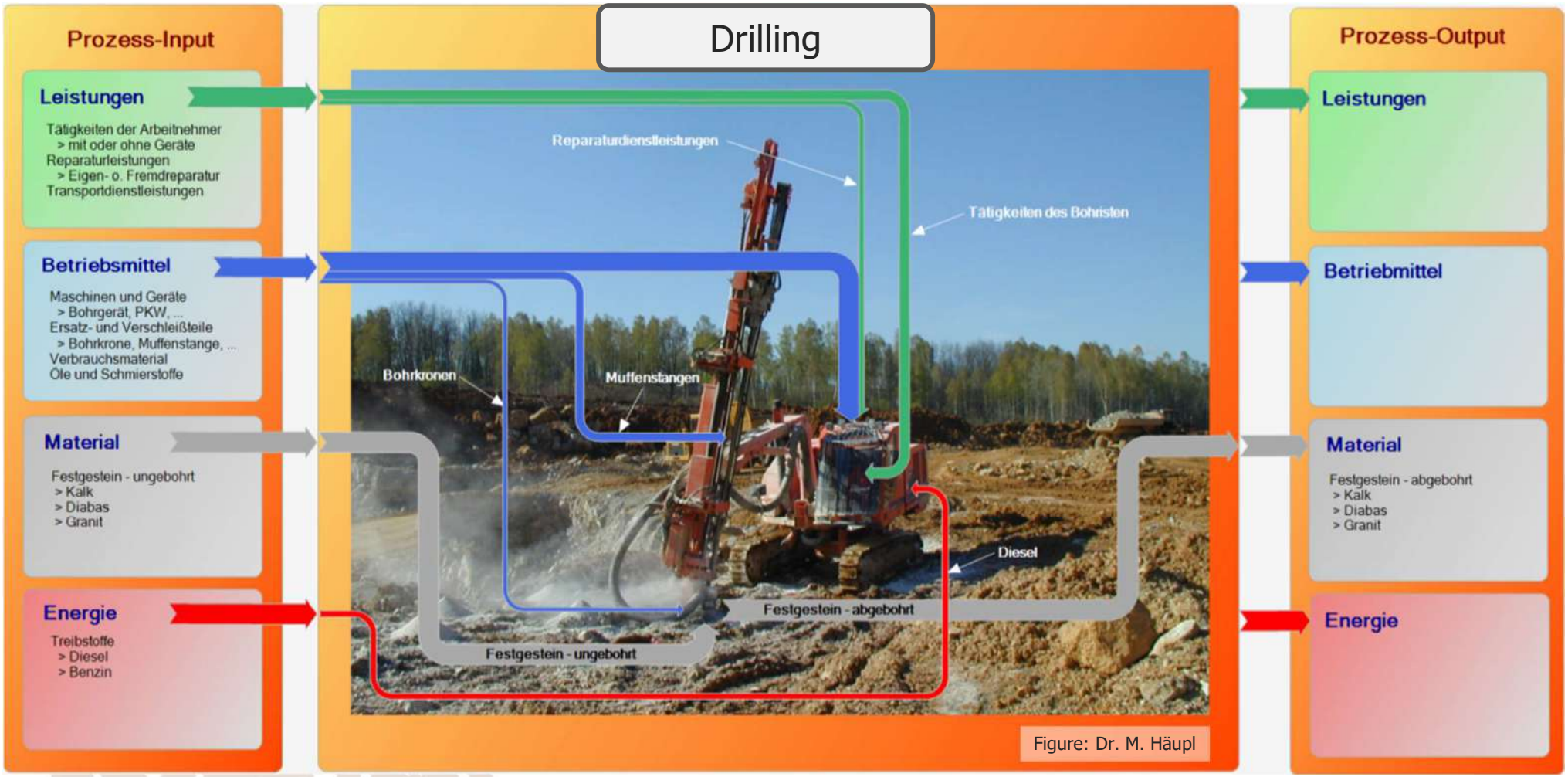


Figure: Dr. M. Häupl

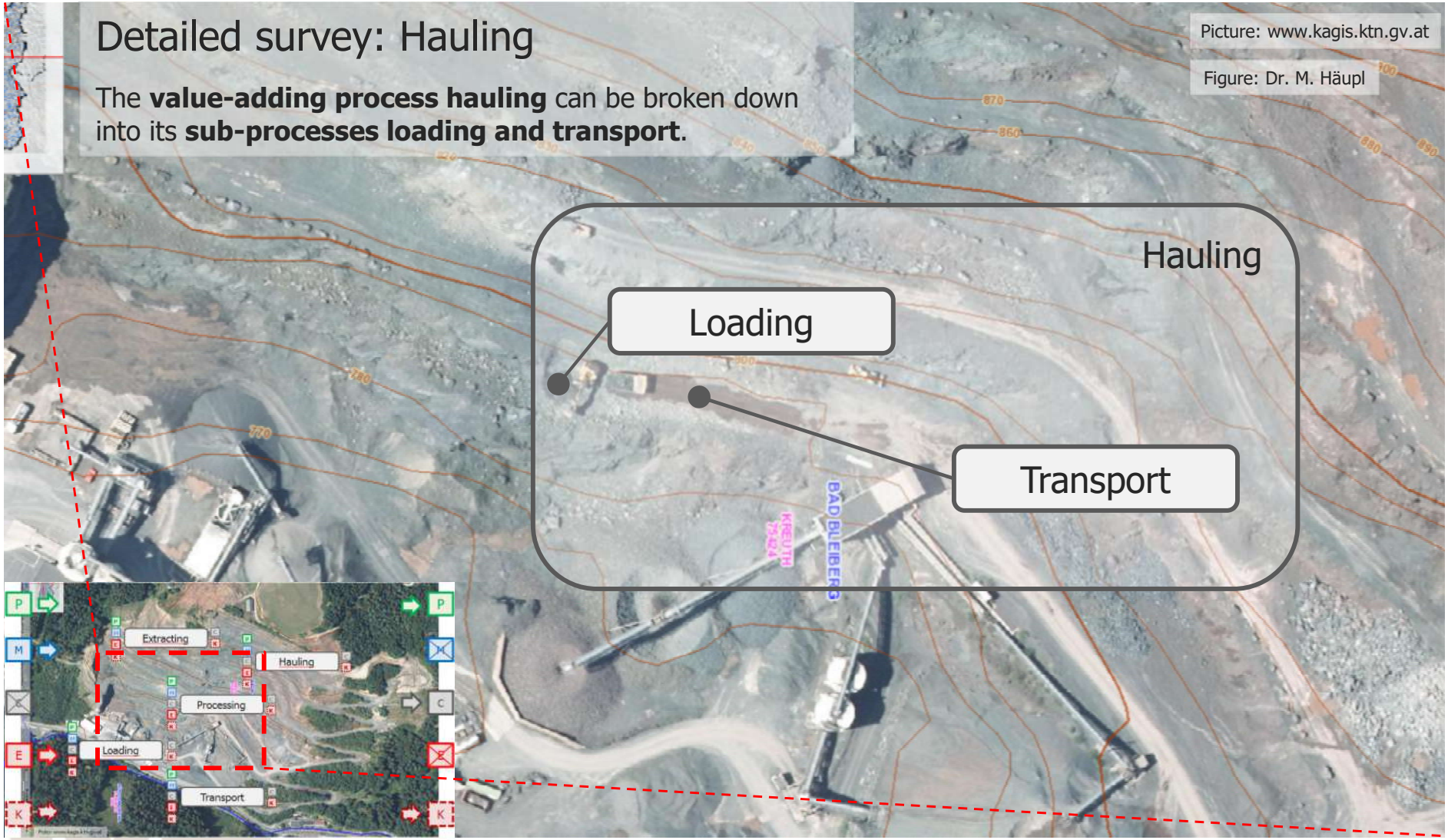
Processes: Structuring

Business processes: Sub processes and production factors

Figure: Dr. M. Häupl

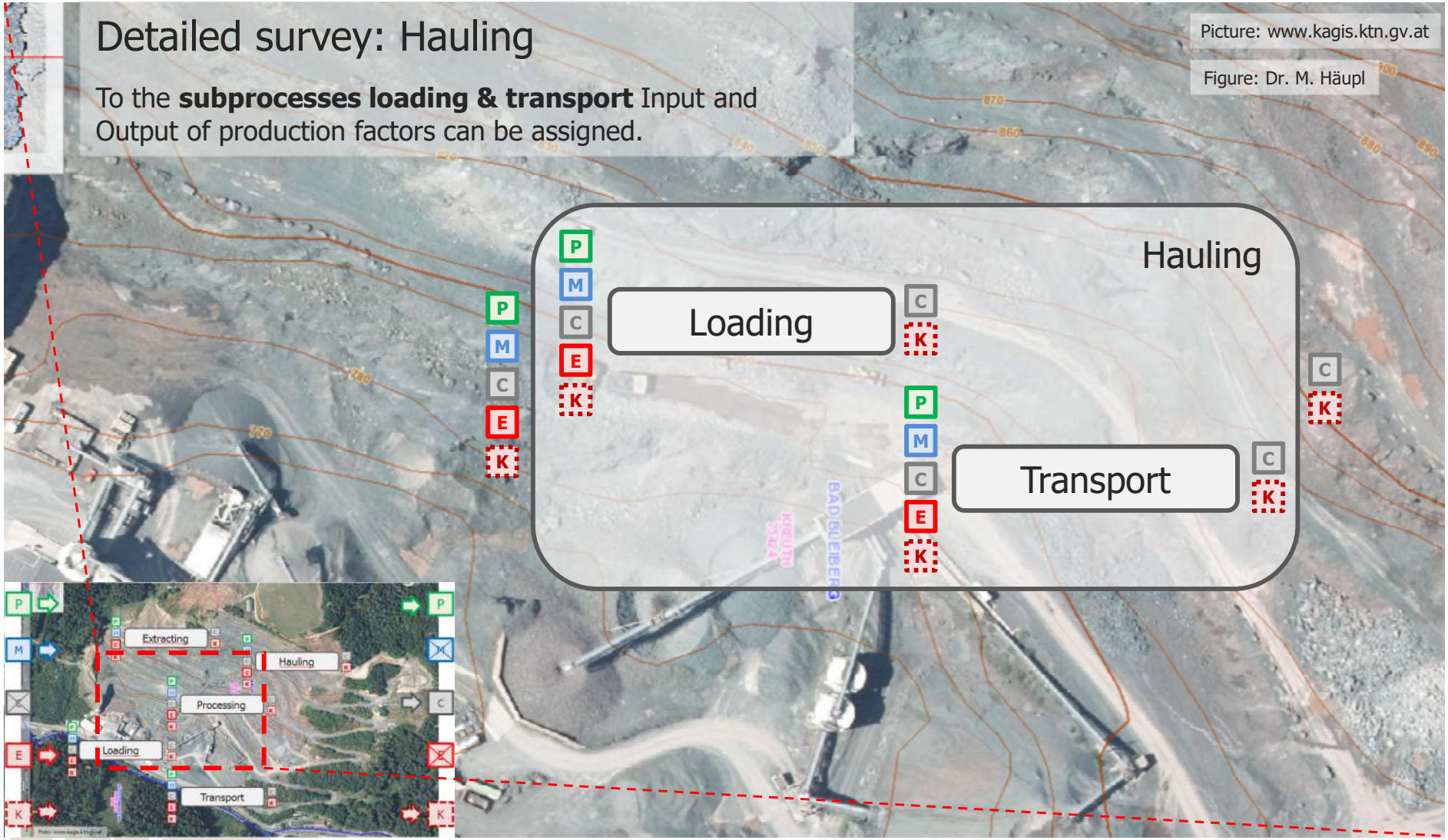
Processes: Structuring

Business processes: Value-adding processes & production factors



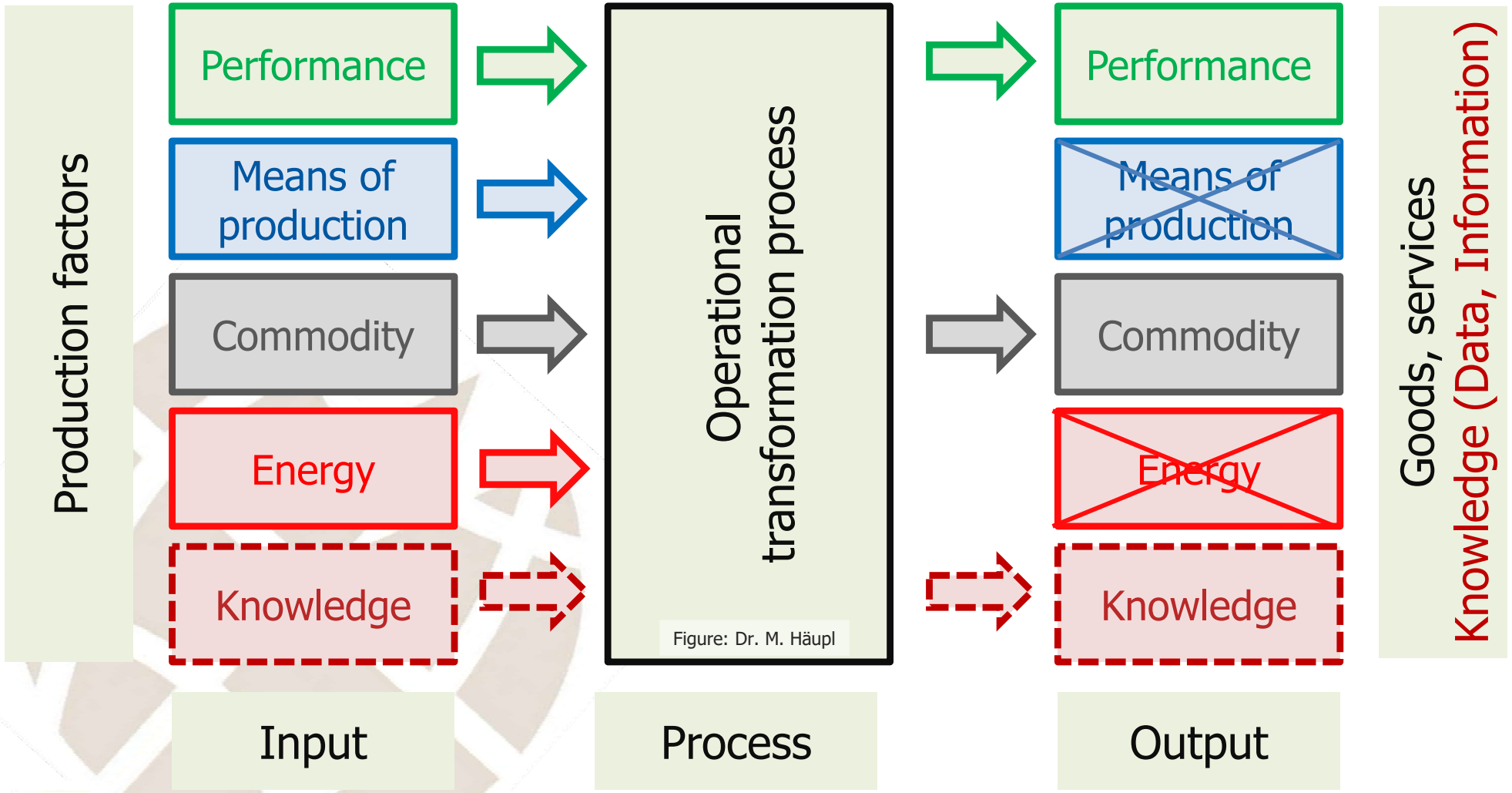
Processes: Structuring

Business processes: Value-adding processes & production factors



Knowledge within the production process

Combination of production factors → Business processes



Processes: Combination

Business processes: Combination through production factors

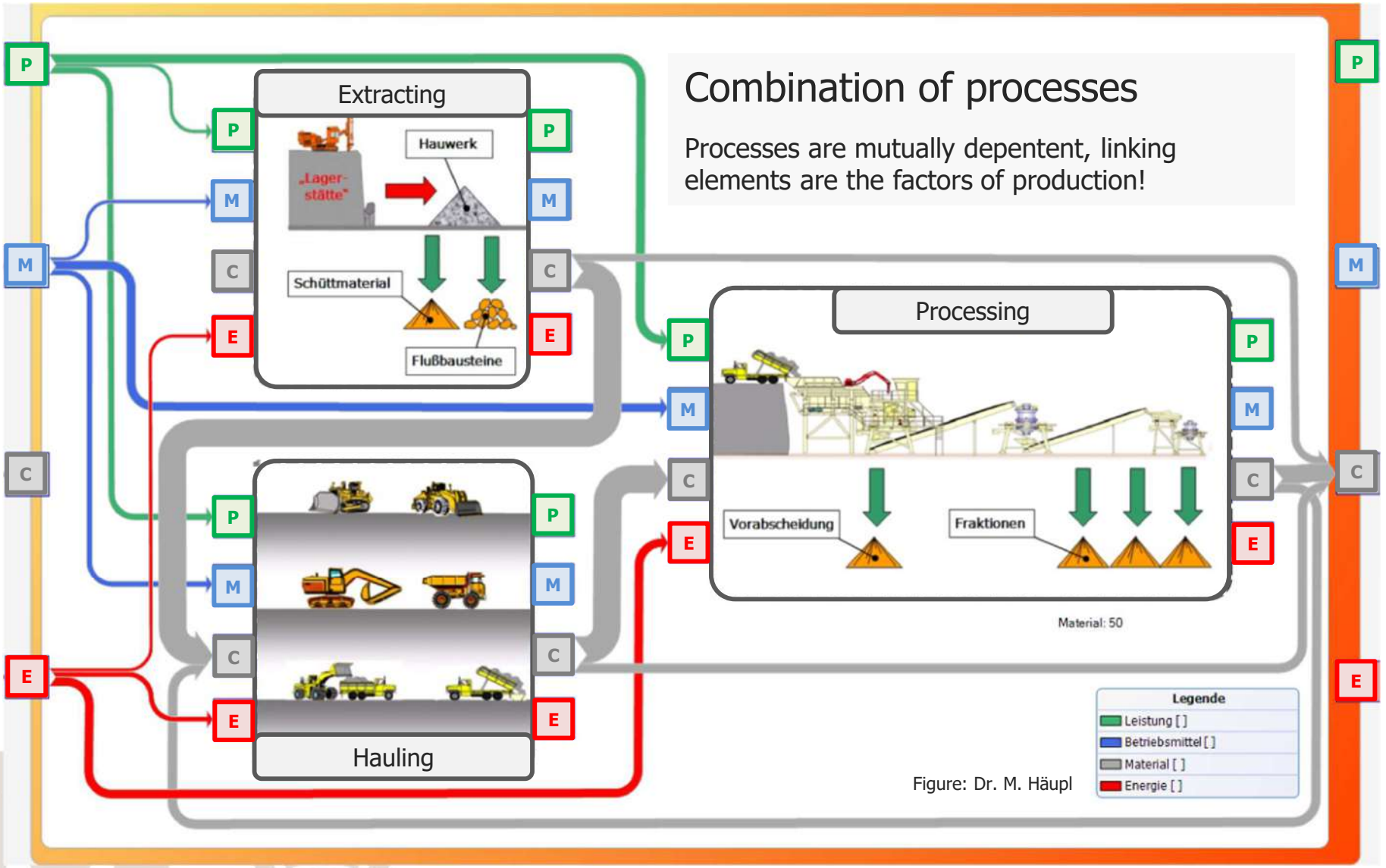


Figure: Dr. M. Häupl

Processes: Storage sites

Business processes: Value-adding processes & production factors

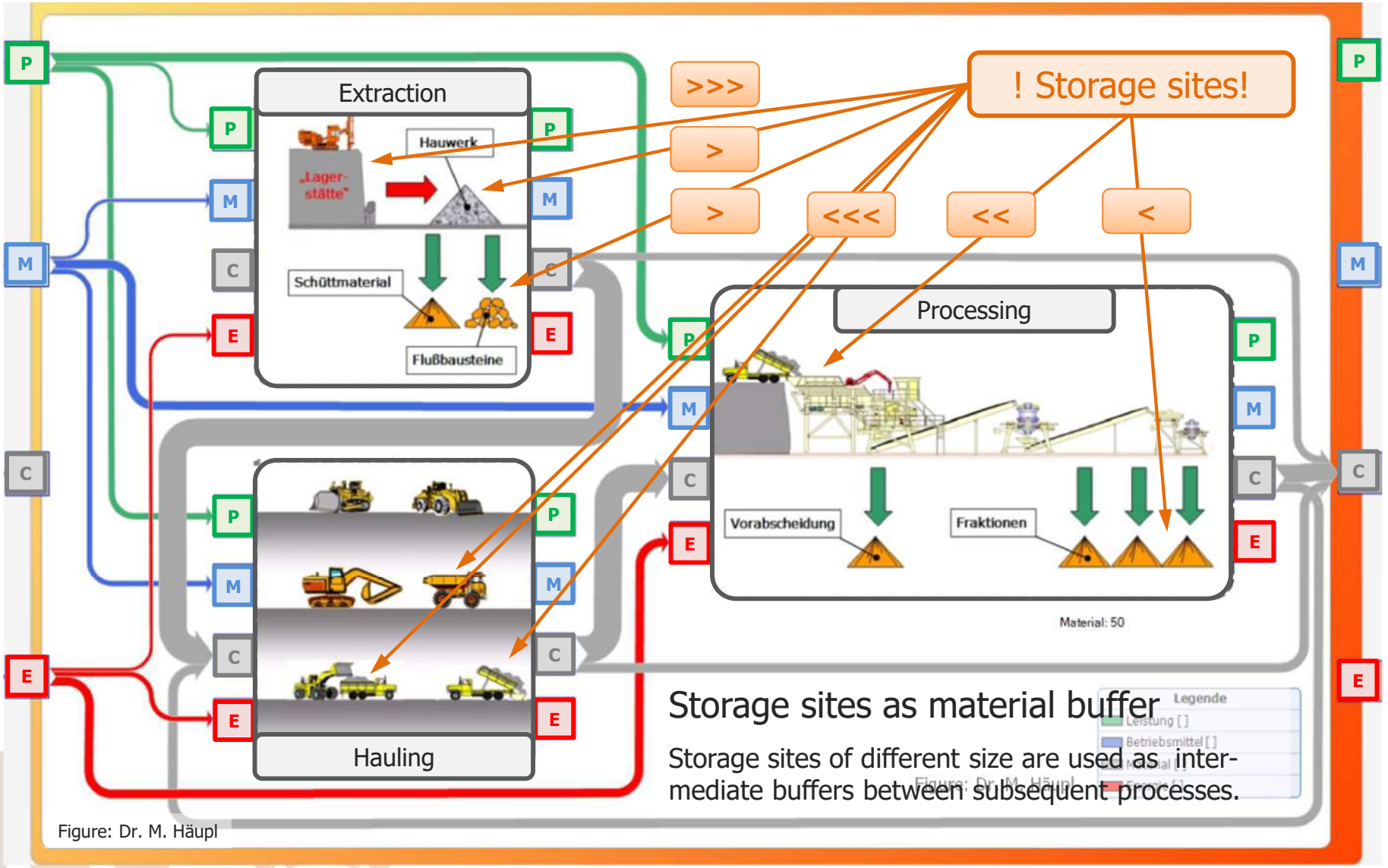


Figure: Dr. M. Häupl

Processes: Typs of processes

Production processes vs.
Manipulation- resp. transportation processes

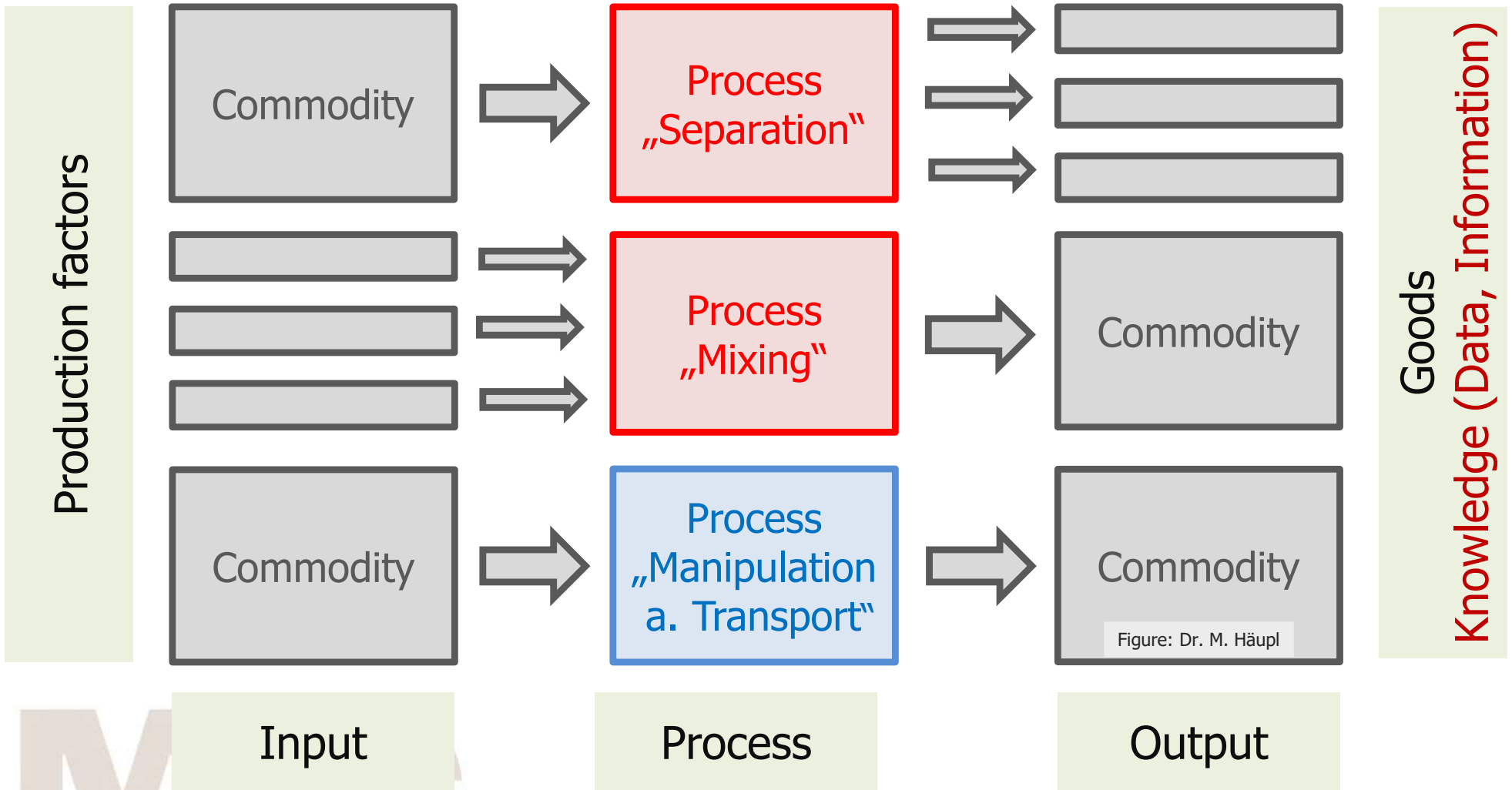
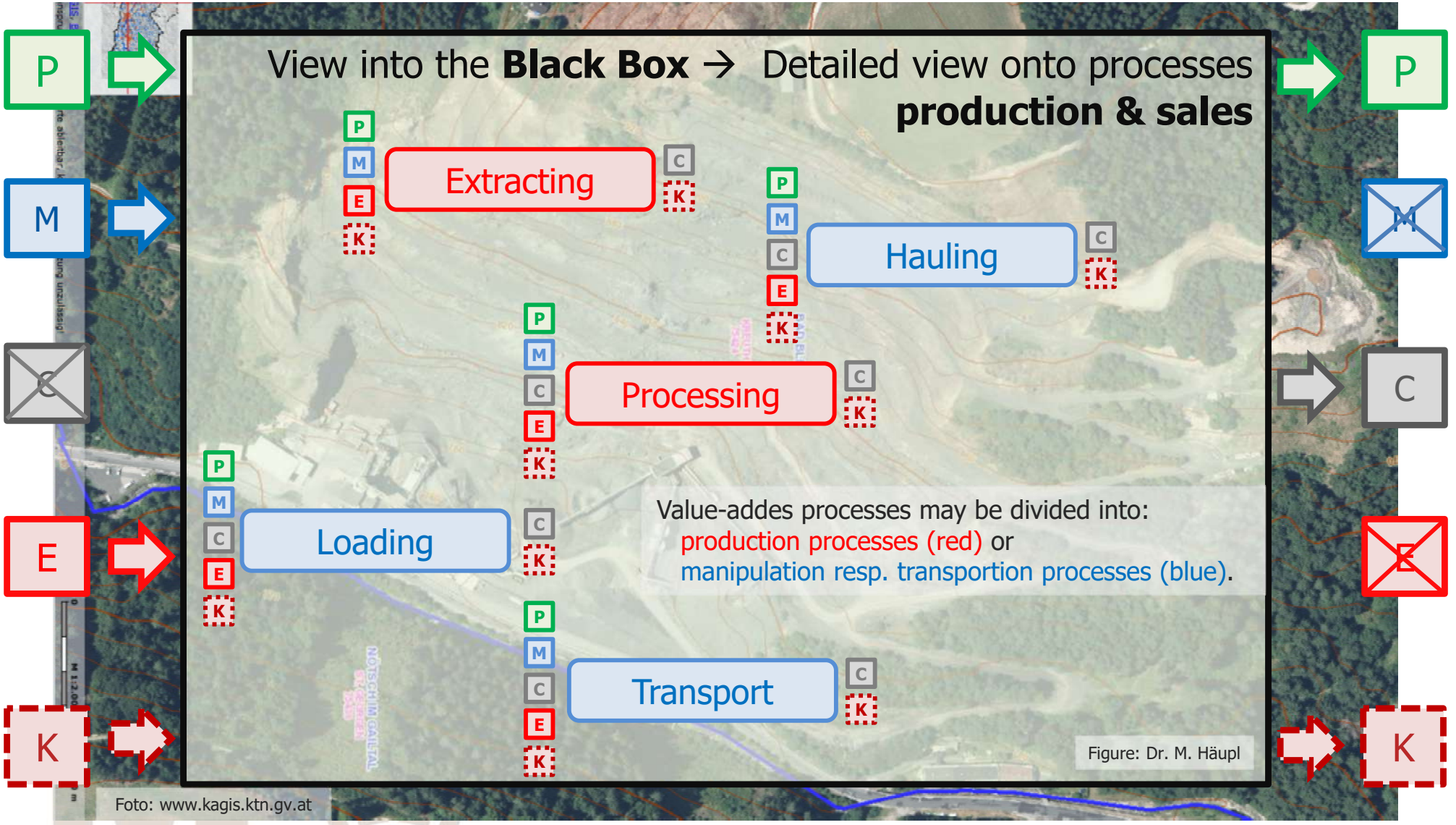


Figure: Dr. M. Häupl

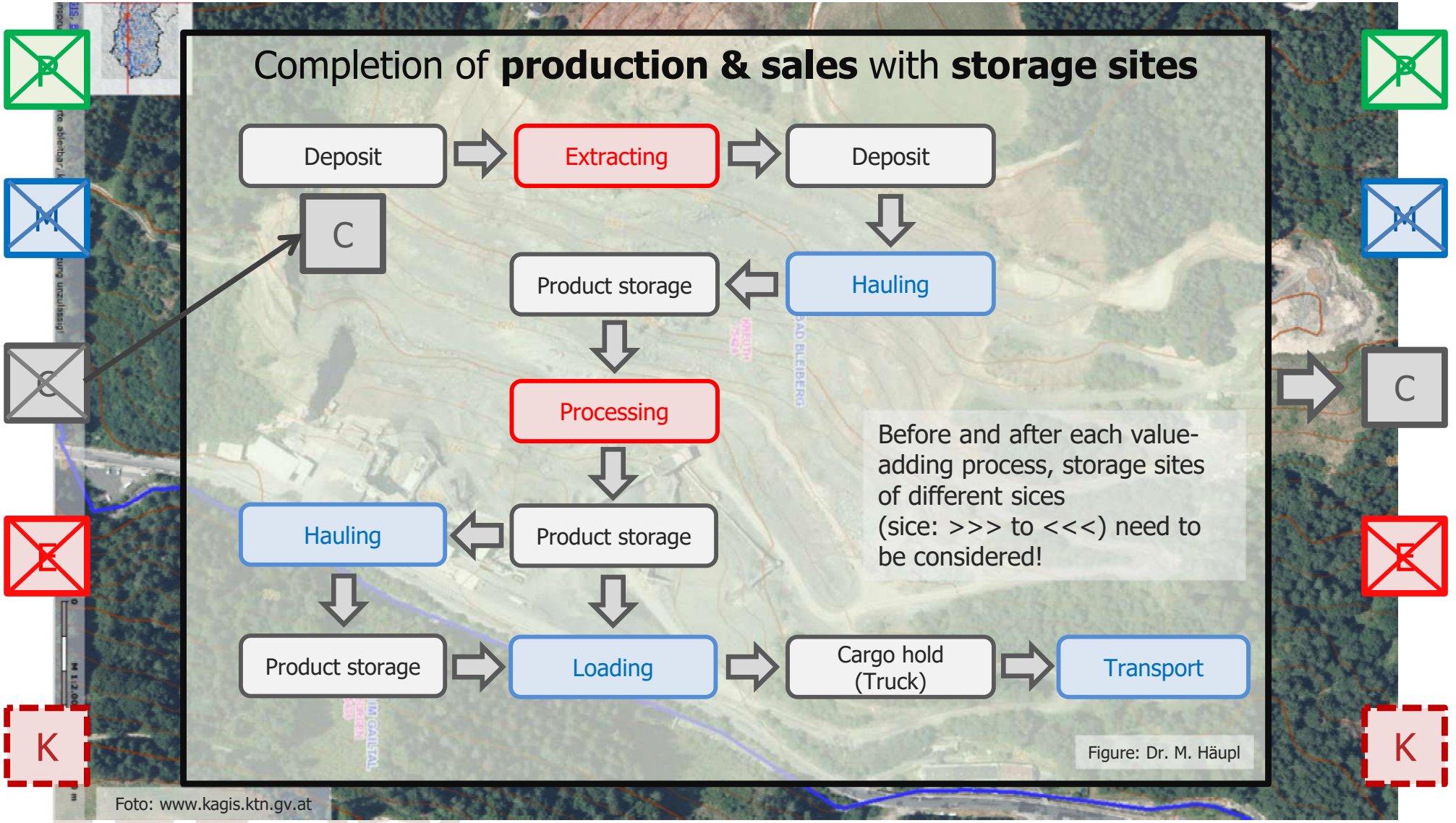
Processes: Types of processes

Business processes: Types of processes & production factors



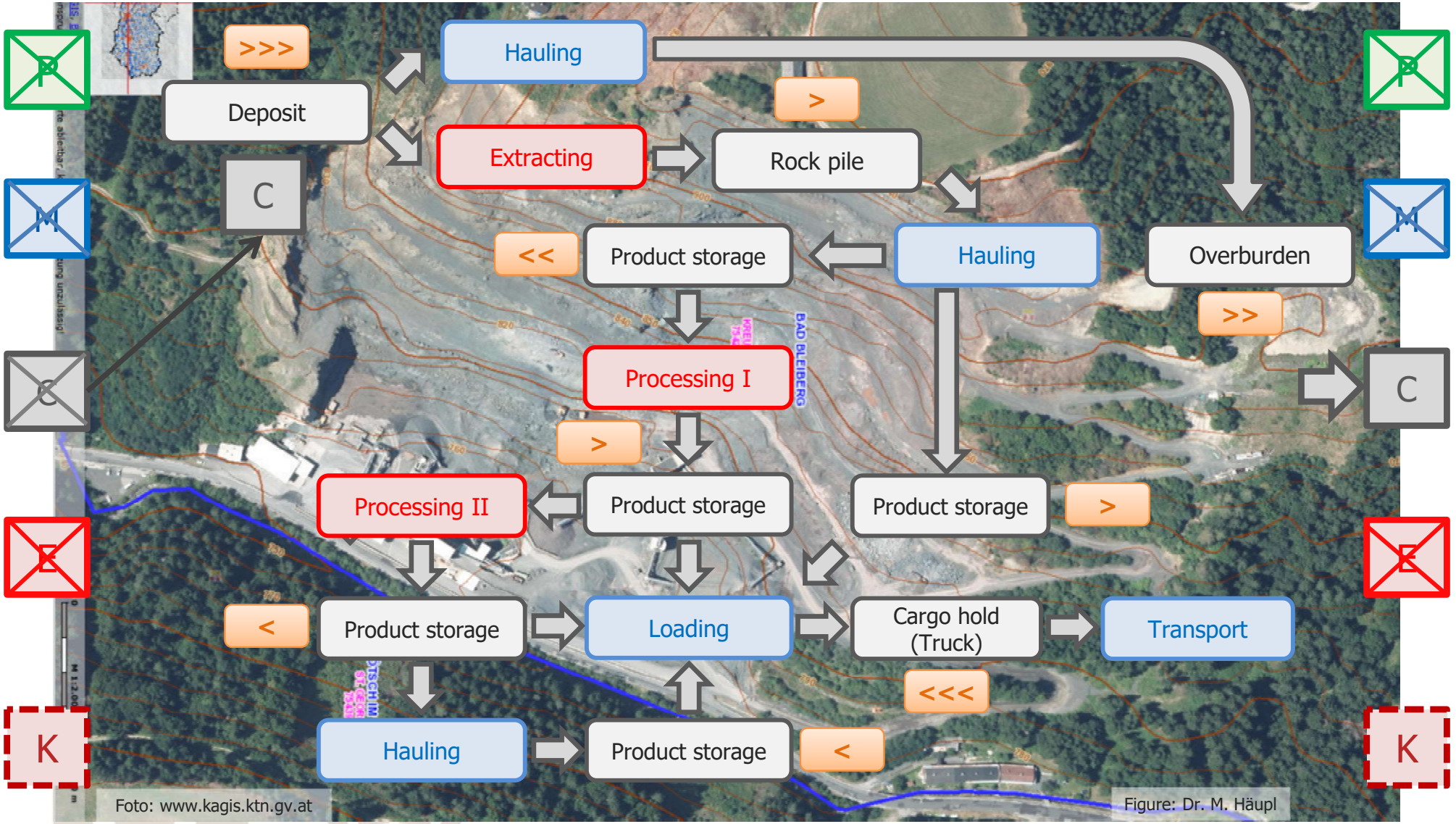
Processes: Addition of storage sites

Business processes: Value-adding processes & storage sites



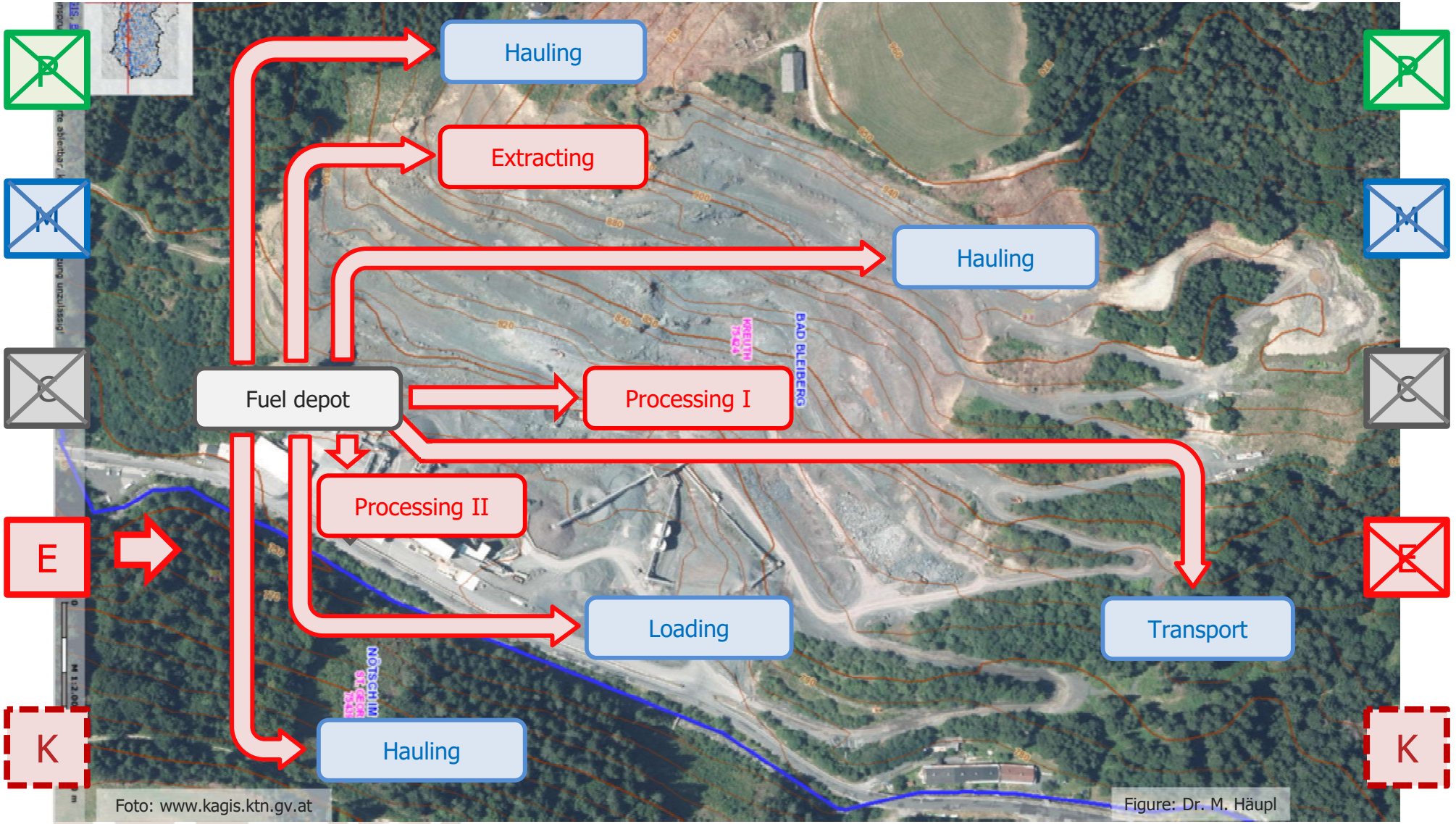
Processes: Commodity flow

Raw material to product: Processes & storage sites in real operation



Processes: Energy flow

Raw material to product: Processes & storage sites in real operation



Processes: Commodity delivery chain

Commodity delivery chain – from raw material to construction site

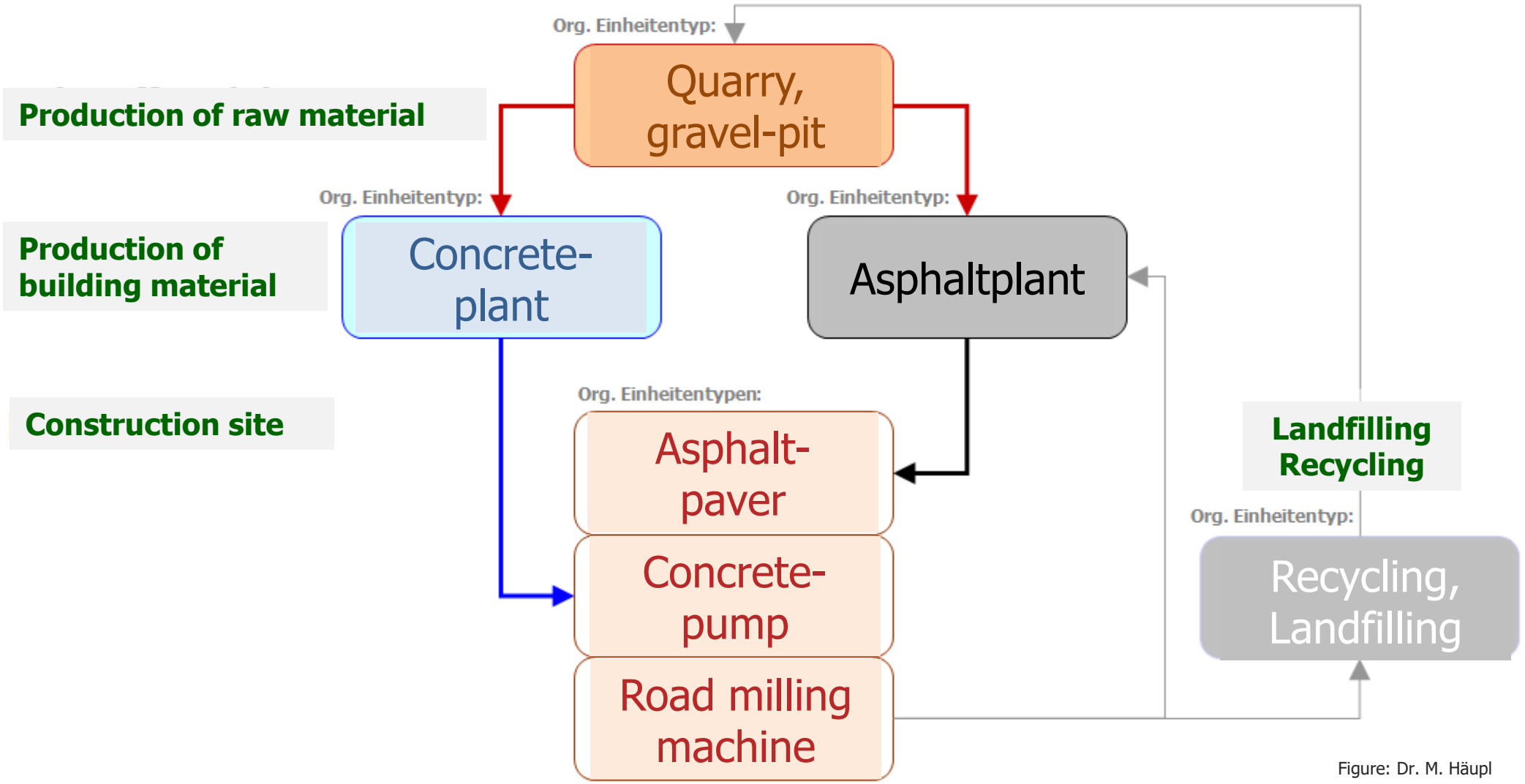


Figure: Dr. M. Häupl

Processes: Value chain

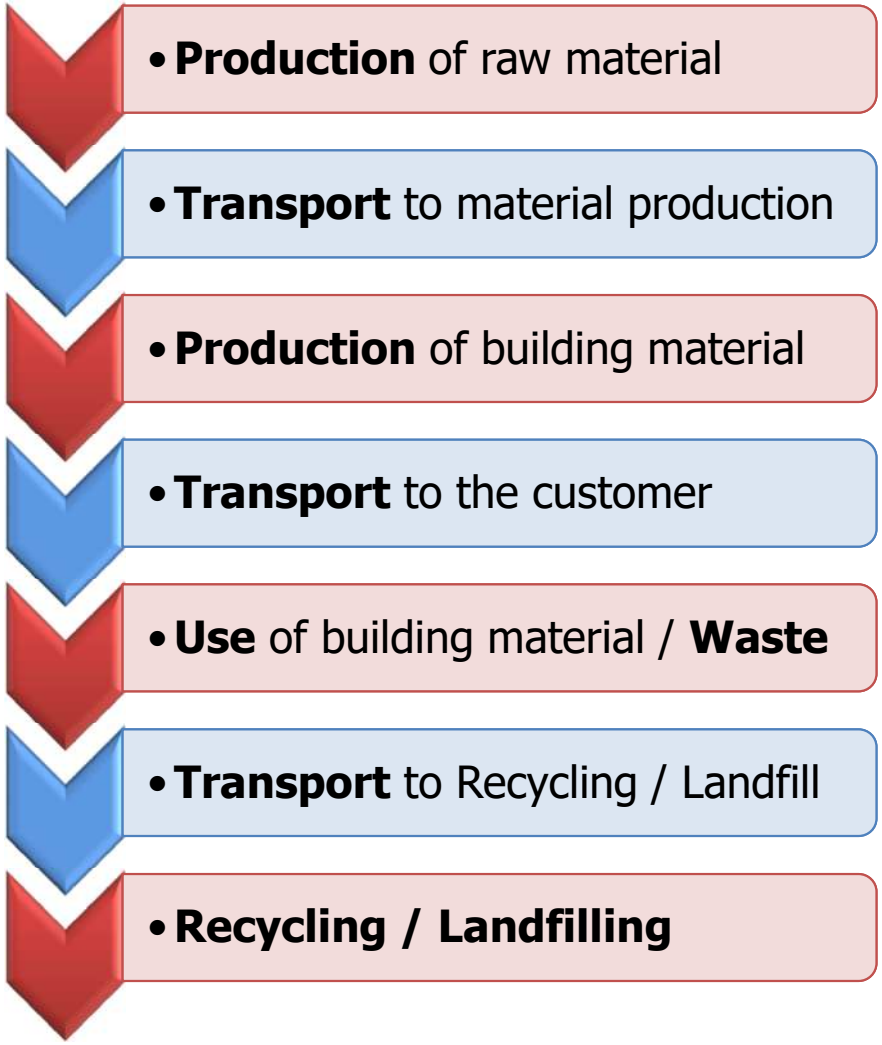
Value chain within raw material and construction industries:

Sequence of

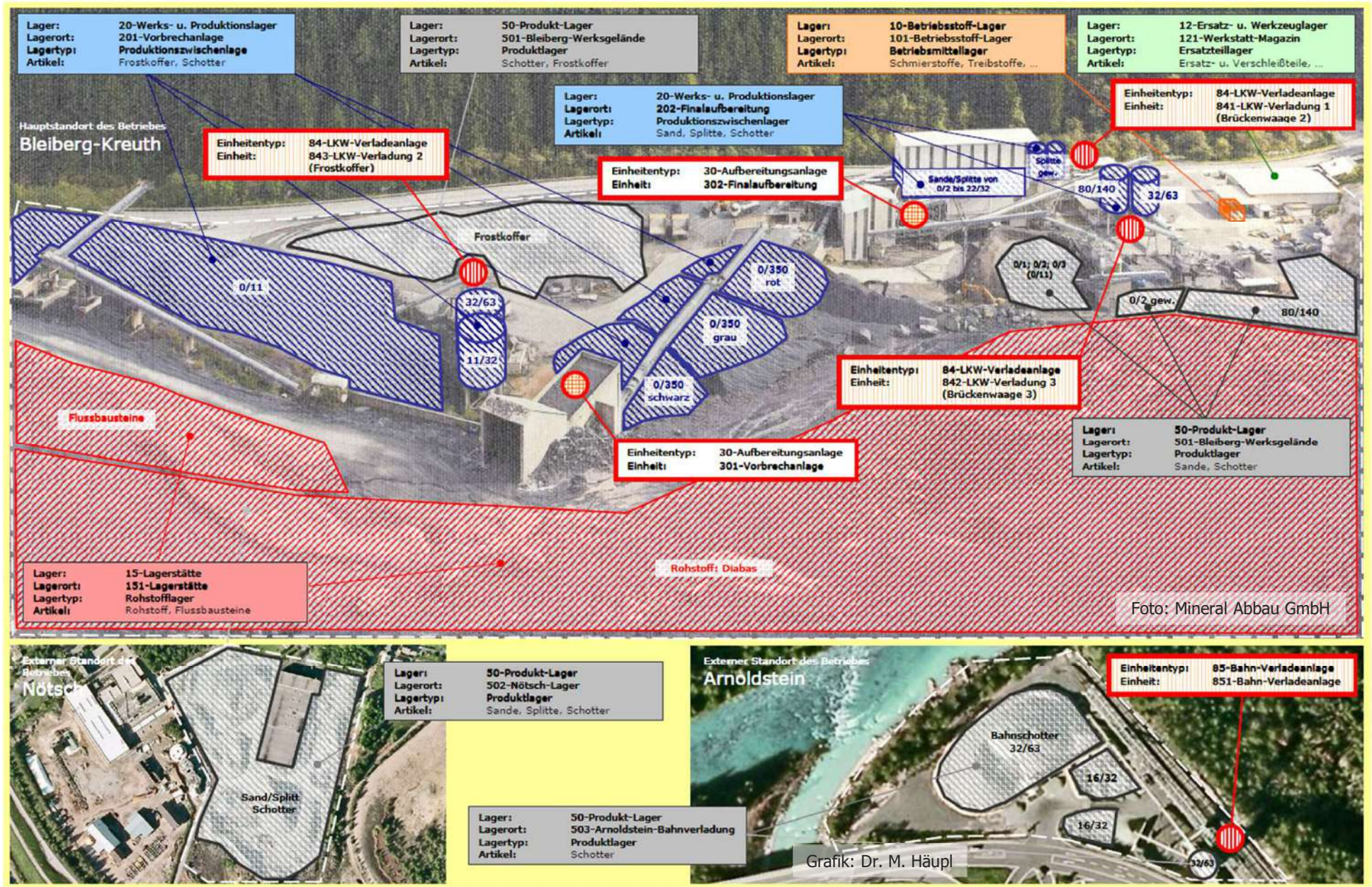
Production processes

as well as

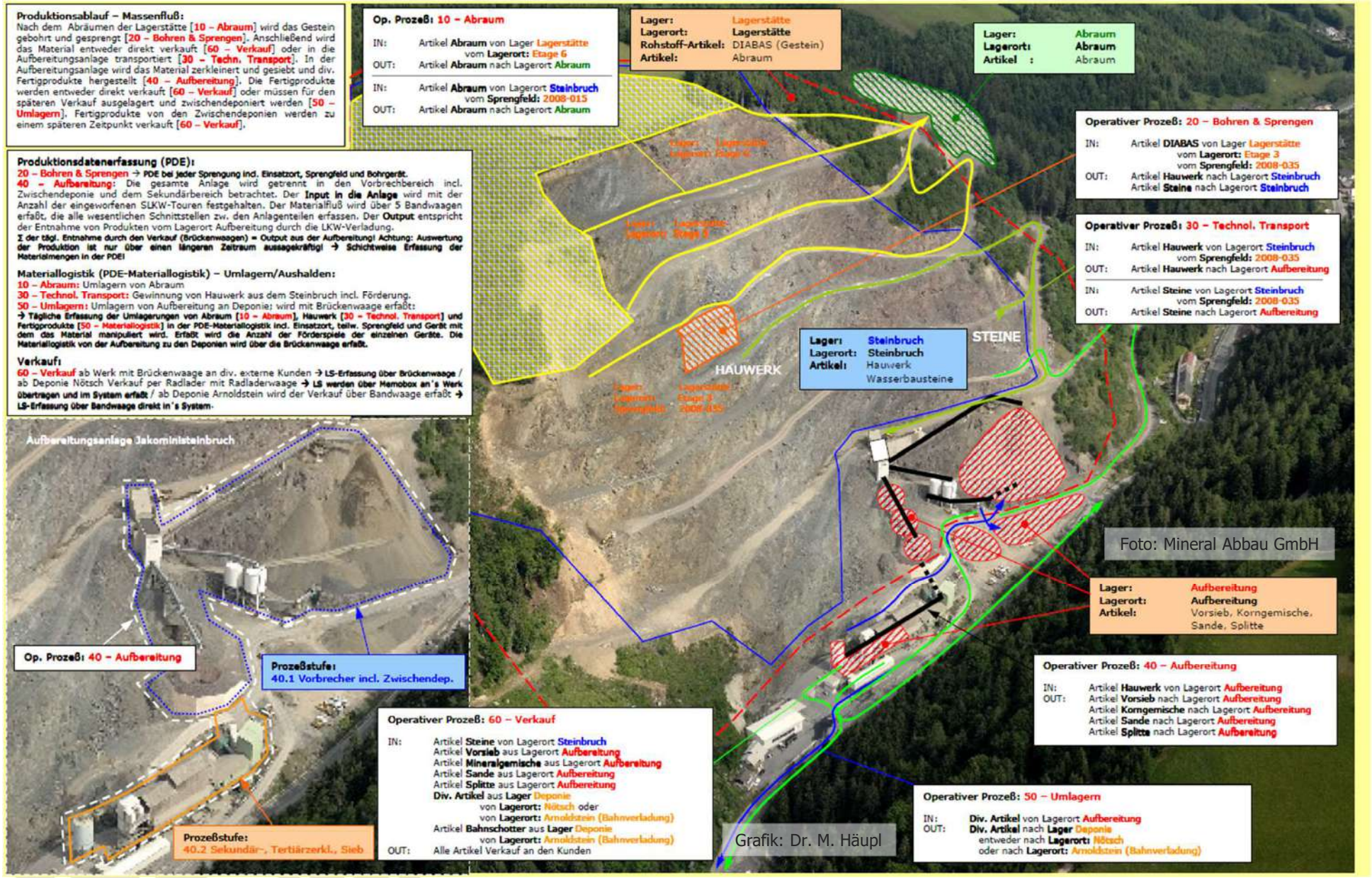
Manipulation- resp. transportation processes



Processes: Example



Processes: Example



3 Enterprise and operational organisation

Organisation

Enterprise and operational organisation

Organisation of resources of

Person & Knowledge

Machine / plant & Energy,

Commodity (= deposit + products)

and their interaction within the business processes (process organisation) as well as their conditions, which are determined by the organizational structure.

Operational organisation

Suppy chain within the company: General consideration in the literature

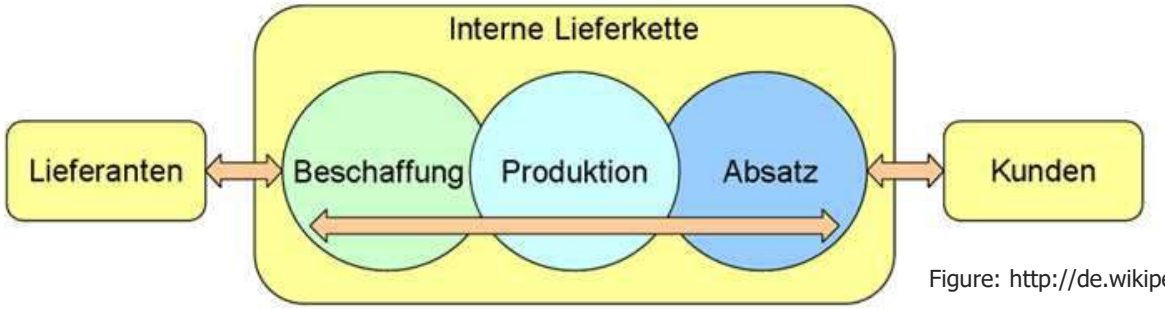


Figure: http://de.wikipedia.org/wiki/Supply_Chain_Management

Supply chain within the company: Modified and extended display

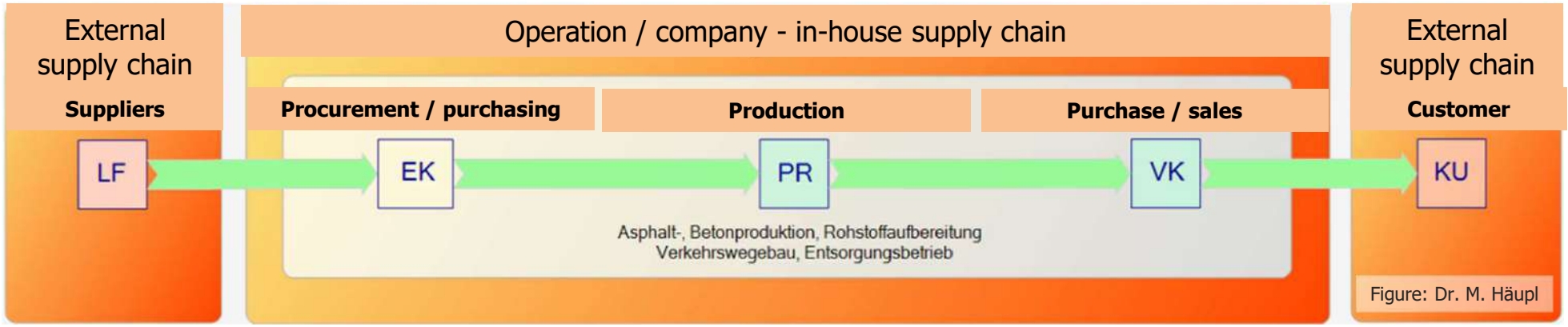


Figure: Dr. M. Häupl

Operational organisation

Supply chain: Value-adding processes & supporting processes

Value chain: Illustration by Michael E. Porter

Operational organisation

Organisational structure: Extension with management processes

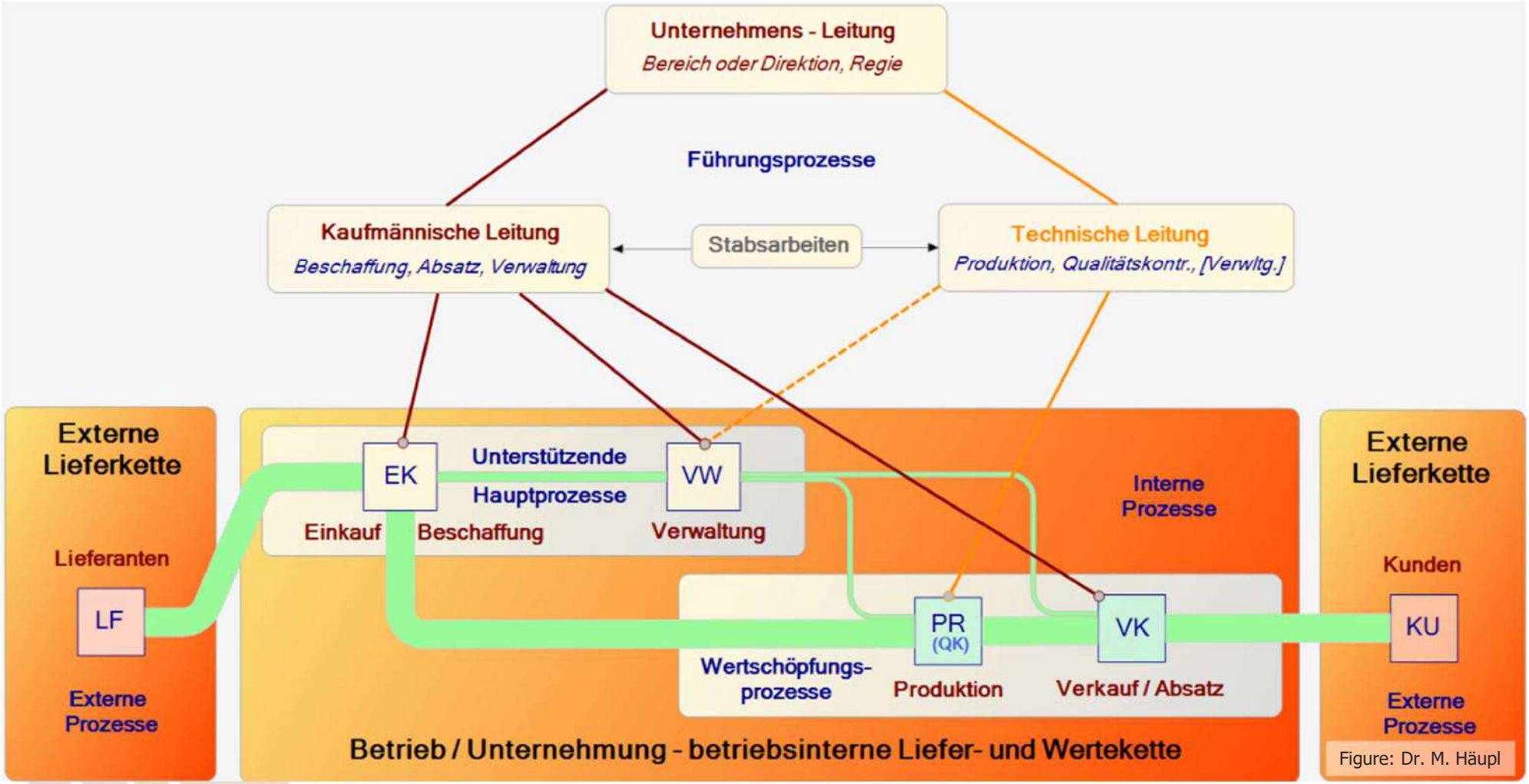


Figure: Dr. M. Häupl

Operational organisation

Main processes: Structure with interaction

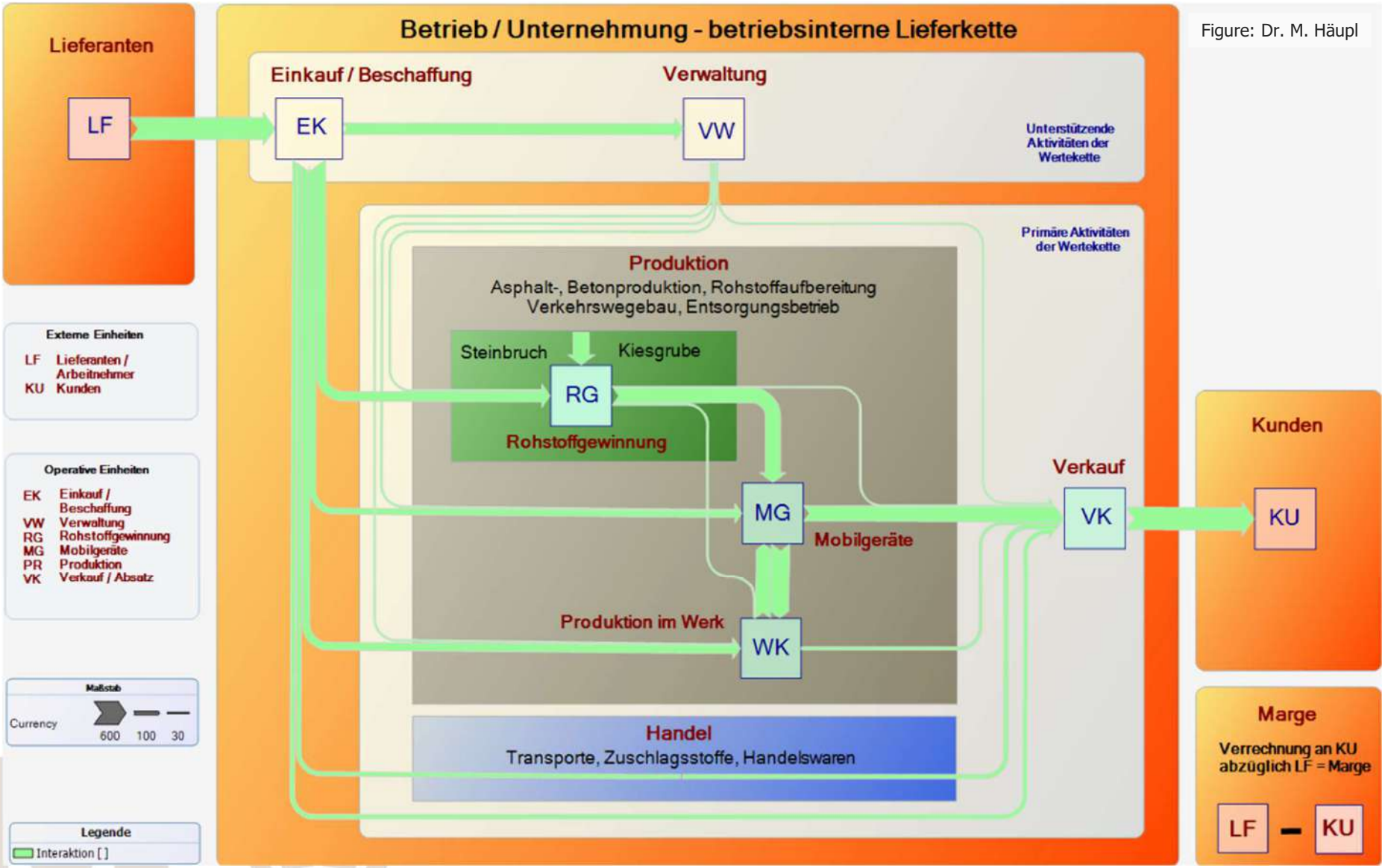


Figure: Dr. M. Häupl

Operational organisation

Main processes: Structure with interaction of production factors

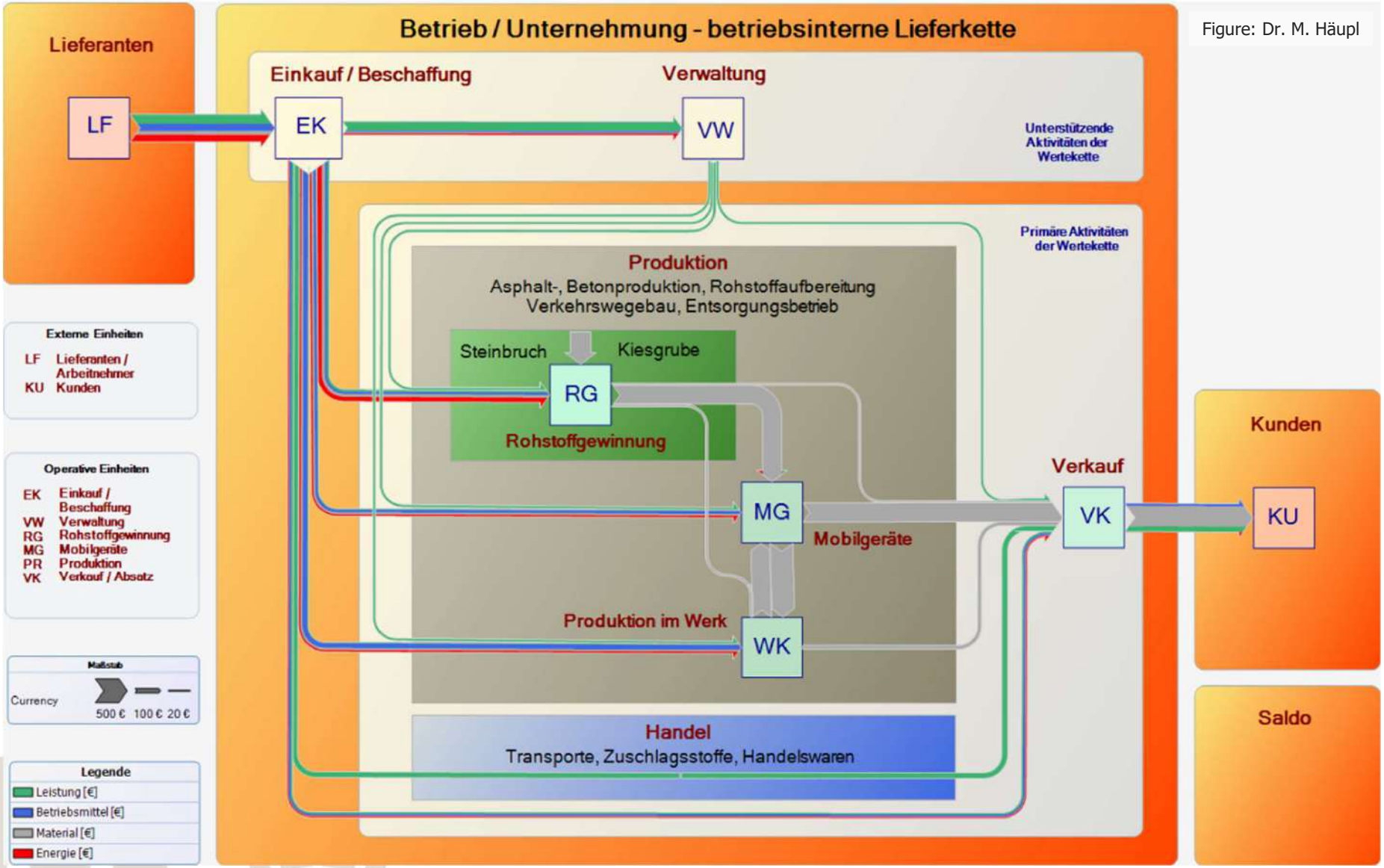
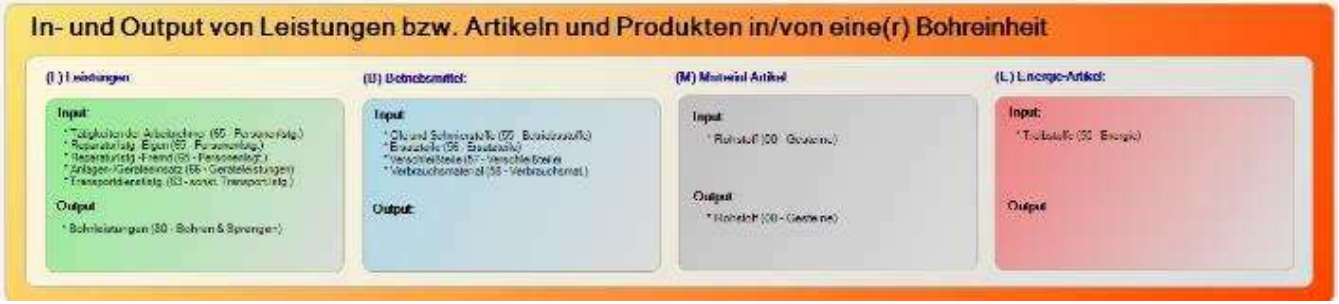


Figure: Dr. M. Häupl

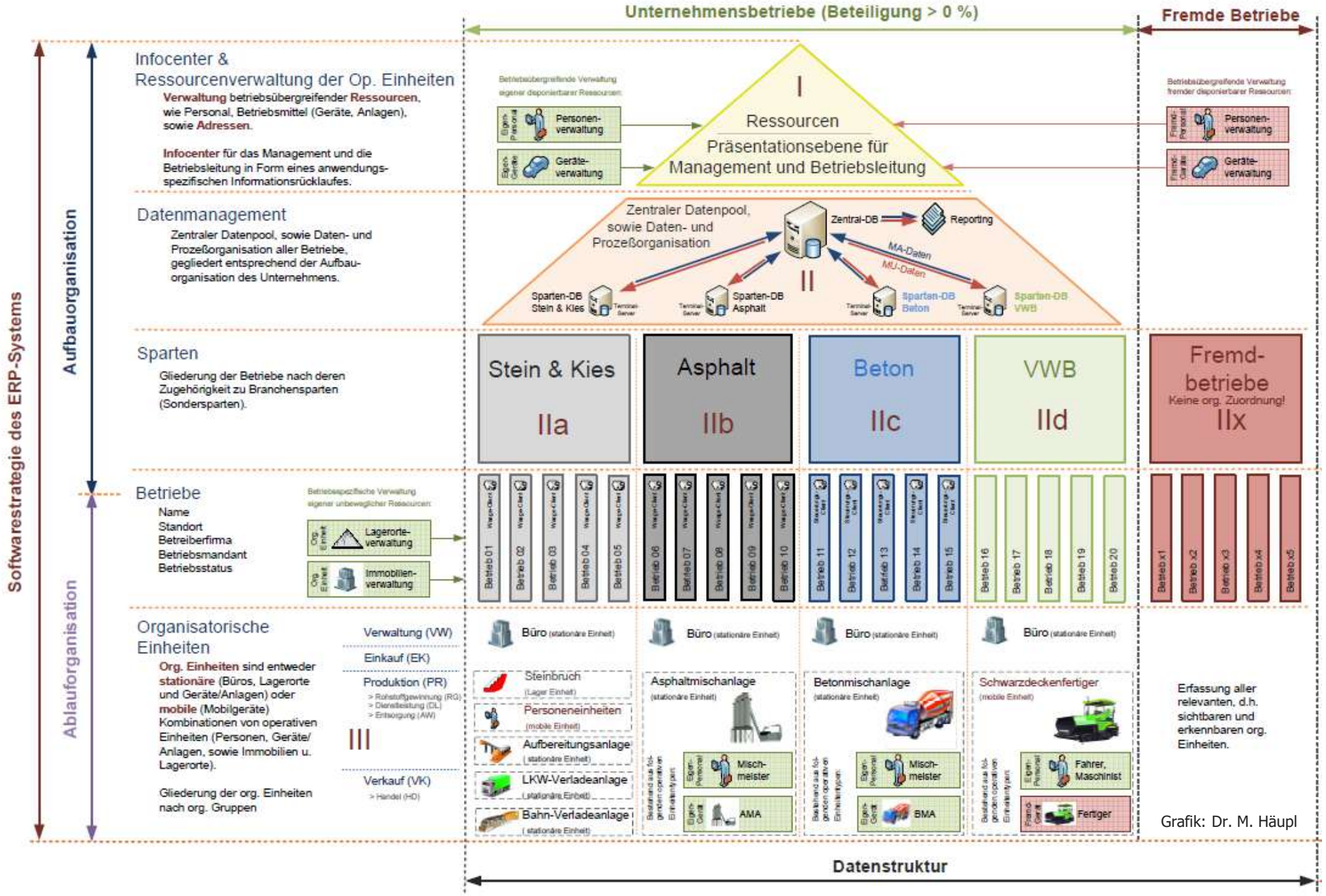
Operational organisation

Business processes: Definition of process participants / information needs

Grafik: Dr. M. Häupl

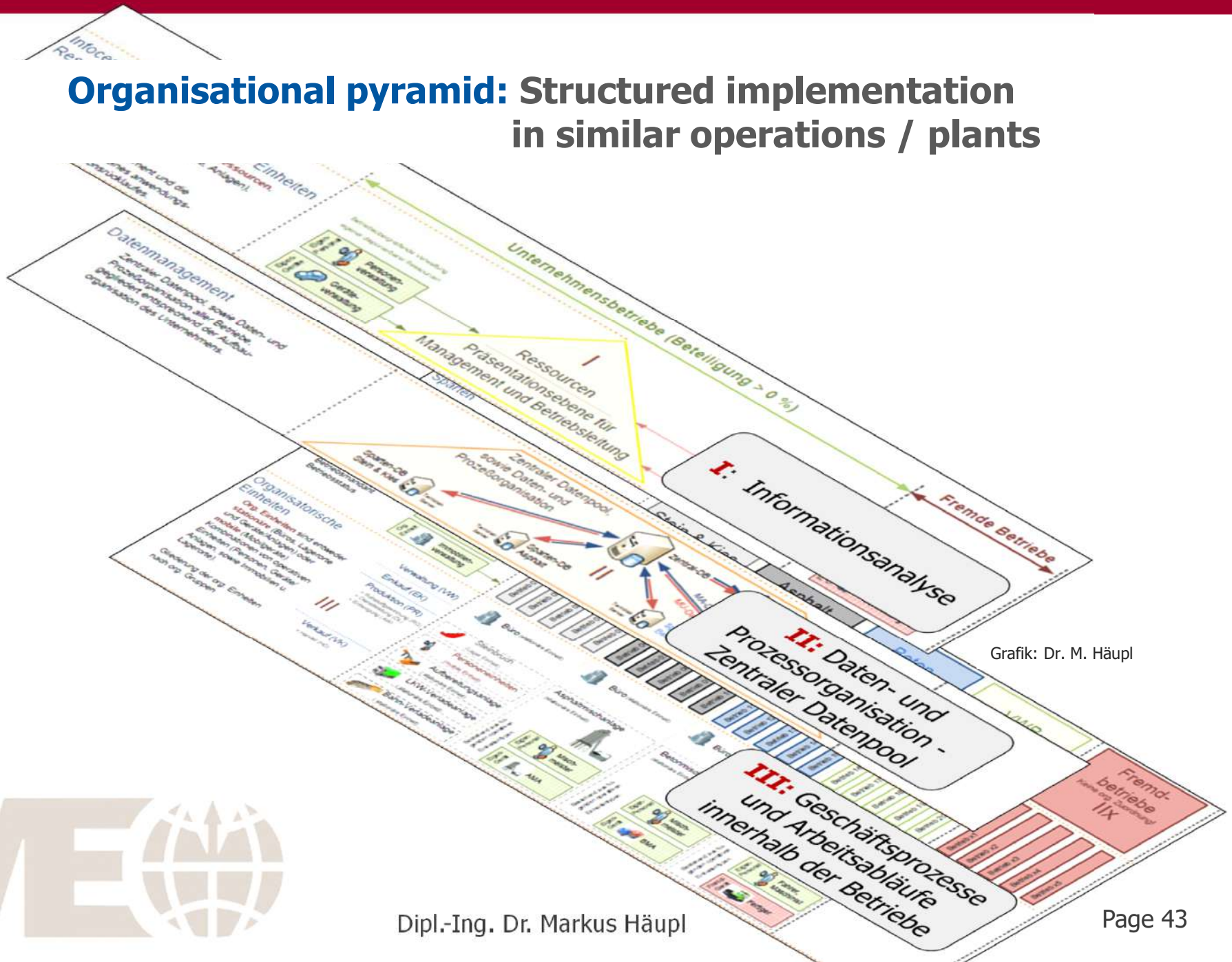


Organisational pyramid



Organisational pyramid

Organisational pyramid: Structured implementation in similar operations / plants



Grafik: Dr. M. Häupl

4 Data management and data analysis

Information and analysis

Data management and –analysis (Knowledge)

Management of all accumulated data and structured assignment to the process participants

Person

Machine / plant & Energy,

Commodity (= deposit + products)

and their analysis in the context of their interaction within the business processes (process organisation) as well as their conditions, which are determined by the organisational structure.

Information processing

Data structure: According of company structure resp. Business processes

Strukturing of the data by Master Data References in terms of

- the **organisational structure** through organisational groups (= divisions / business units)
- the **organisational departments resp. plants / storage sites** in org. unit types
- the **process organisation** by mapping of business processes (= functionality of software)
- the **process participants** (operational types) on business processes / work flows
  > People, grouped by functions
  > Equipment, grouped by device groups and –typs (= reference devices)
- the **factors of production**, that are consumed / produced within the business processes
  > Services – from people excl./incl. devices (reference services)
  > Goods – Commodity, supplies, energy (reference article)
- the **storage** of goods, referenced by reference storage sites and storage types
- many other defined references within the system (vehicle types, addresses, …)

Information processing

Master data references

Virtual Data Layer – Data References

Establishment of an industry-spedific, cross-company, international (multi-lingualism!) and especially physically distinct (observable) operating and corporate data structure. These structure allready represents an operational business process model itself.

Physical data layer:

An assignment of all real operational data towards the virtual data layer must be possible, the operational data is referenced.

Information processing

Master data references: Example of reference articles for stone & gravel

Referenzartikel Stein & Kies
incl. Verrechnungsarten

> in Anlehnung an die Normen EN 12620, EN 13043, EN 13242, EN 13285, EN 13383-1 und EN 13450.
> alle **Produktgruppen in roter Farbe** sind als **Produktgruppen** auf dem **BAB** (Betriebsabrechnungsbogen) anzuführen.

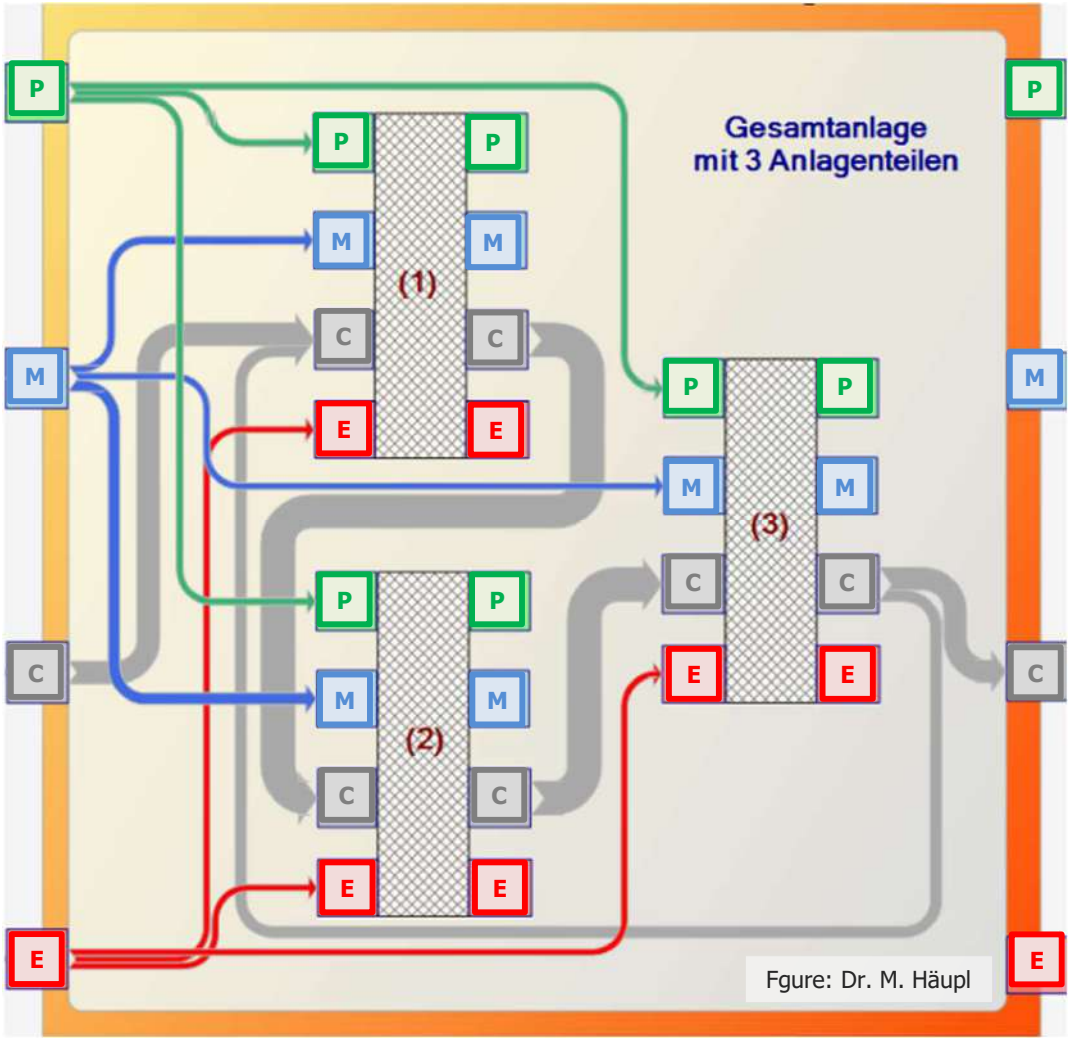
	Produktgruppen	Verrechnungsart	Korngröße		Zusätzliche Bezeichnung der Korngruppen					
					natürlich (nicht gebrochen)		gebrochene Gesteinskörnung			
							natürlich		rezykliert	
			Obere	Untere	Definition	Referenzartikel	Definition	Referenzartikel	Definition	Referenzartikel
Gesteinskörnungen	Füller [1]	KS	0,063 mm	0 mm	---	Füller	---	Füller		
	Sande	NA	≤ 2 bis ≤ 6,3 mm	0 mm	Sand	Natursand 0/1	Brechsand	Brechsand 0/1	Asphaltbrechsand	
	Bezeichnung lt. EN: Feine Gesteinskörnungen					Natursand 0/2		Brechsand 0/2	Betonbrechsand	
						Natursand 0/3		Brechsand 0/3	Bauwerksbrechsand	
						Natursand 0/4		Brechsand 0/4		
	Kiese, Splitte	NB	≤ 32 mm	≥ 2 bis ≥ 4 mm	Kies	Kies 2/4	Splitt	Splitt 2/4	Asphaltsplitt	
	Bezeichnung lt. EN: Grobe Gesteinskörnungen				(Rundkies)	Kies 2/5		Splitt 2/5	Betonsplitt	
						Kies 4/8		Splitt 4/8	Bauwerksplitt	
						Kies 5/8		Splitt 5/8		
						Kies 8/11		Splitt 8/11		
						Kies 8/16		Splitt 8/16		
						Kies 11/16		Splitt 11/16		
						Kies 16/22		Splitt 16/22		
						Kies 16/32		Splitt 16/32		
						Kies 22/32		Splitt 22/32		
						Kies 22/45		Splitt 22/45		
	Kiese, Splitte veredelt	NC								
	Bezeichnung lt. EN: Grobe Gesteinskörnungen		≤ 32 mm	≥ 2 bis ≥ 4 mm	Kies erh. Anf.	Kies veredelt 2/4	Splitt erh. Anf.	Splitt veredelt 2/4	Asphaltsplitt	
					(gebr. Rundkies)	Kies veredelt 2/5	(Edelsplitt)	Splitt veredelt 2/5	Betonsplitt	
						Kies veredelt 4/8		Splitt veredelt 4/8	Bauwerksplitt	
						Kies veredelt 5/8		Splitt veredelt 5/8		
						Kies veredelt 8/11		Splitt veredelt 8/11		
						Kies veredelt 8/16		Splitt veredelt 8/16		
						Kies veredelt 11/16		Splitt veredelt 11/16		
						Kies veredelt 16/22		Splitt veredelt 16/22		
						Kies veredelt 16/32		Splitt veredelt 16/32		
						Kies veredelt 22/32		Splitt veredelt 22/32		
						Kies veredelt 22/45		Splitt veredelt 22/45		
	Schotter	ND								
			≤ 45 mm	≥ 32 mm	Grobkies	Grobkies 32/45	Schotter	Schotter 22/50		
						Grobkies 32/X		Schotter 22/63		
						Grobkies 50/X		Schotter 32/45		
						Grobkies 63/X		Schotter 32/50		
								Schotter 32/63		
								Schotter 32/80		
								Schotter 50/63		
								Schotter 22/X		

Tabelle: Dr. M. Häupl

Information analyses

Business processes: Analysis by means of Sankey-Diagramms

- Analysis with Sankey-Diagrams
- Predestined for mass fluxes, as the connection arrows are shown quantities-proportional,
  - > thick arrow → large amount,
  - > thin arrow → small amount
- Energy waste may be recognized easily, as large consumers will have thick red arrows.
- Requirement is a process-oriented definition of the operational processes.



Information analyses

Reporting system: Pre-definition of the required analyses

Pre-definition of standardized analyses (main processes!)

- Sales, Procurement / Purchasing
- Inventory management, Inventry
- Production and operating data
- Commercial evaluations

Other requirements of the analyses (System)

- Adaption to hierarchy (reporting level)
- Multilinguale Design

Interactive and flexible reporting

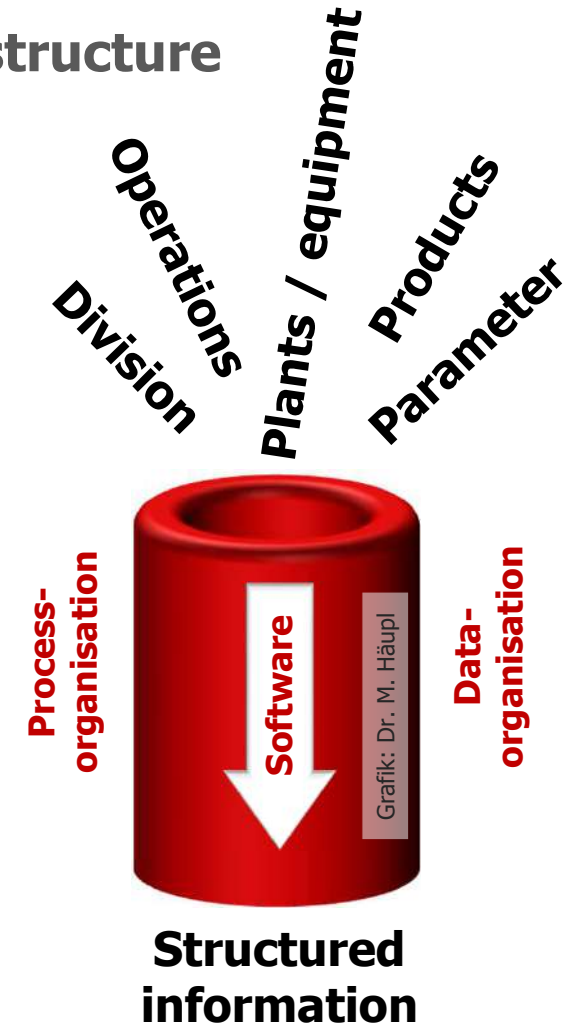
- Interactive reporting can be done by business intelligence tools (BI-Tools)
- A well-structured database is required (Data references!)

Information analyses

Data & Processes: advantages of a transparent structure

Transparent structuring of the company by

- an extensive **process organisation** by
  - > a homogeneous / comparable business process landscape
  - > enforcement of an uniform working method of employees
  - > comparable and transparent work flows
  - > simple dissemination of well-functioning processes
- a sophisticated **date organisation** through
  - > extensive master data references under
  - > compliance of physical laws and
  - > compliance of the organisational enterprise framework
- a flexible **software strategy** in terms of
  - > operational complexity,
  - > company size and
  - > information needs



Information analyses

Structured data and processes: advantages for the management

Advantages for the management in the following respects:

- Company-wide **standard** for all types of operations
- Uniform **transnational** and **inter-enterprise information**
- Design of an inter-enterprise indicator system
- Measures to increase productivity are verifiable
- Technical an commercial controlling grow together
- An **efficient controlling of operations** is ensured

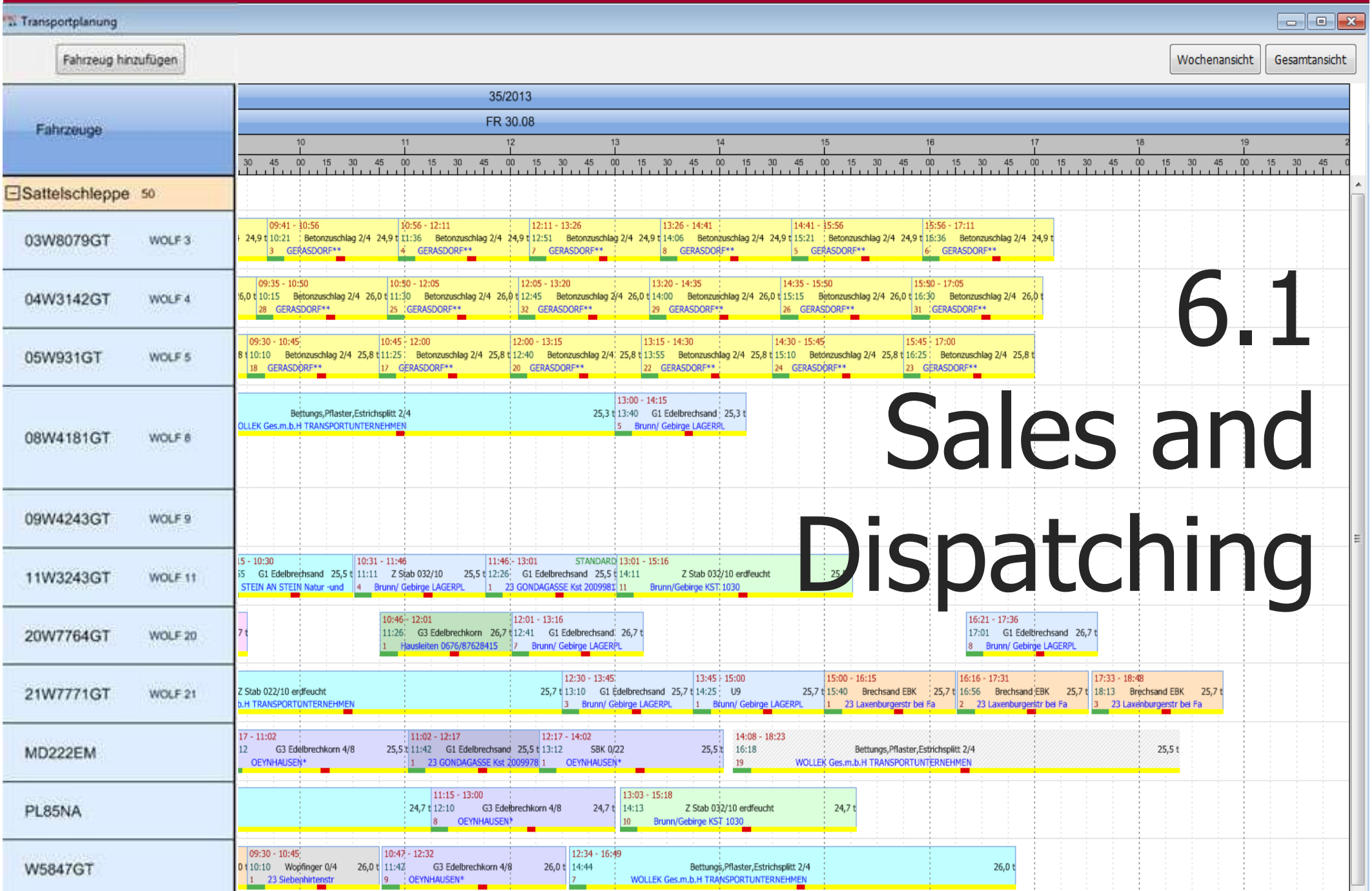
5 Automation of business processes

Automation of business processes

Automation of business processes are shown on the basis of the following examples:

- Sales and dispatching (of commodities)
- Truck-Selfservice-Terminal
  (Inbound and outbound deliveries)
- Fully automated truck-loading plant
- Wheelloader-Terminal
  (Outbound deliveries / internal manipulation of commodities)

Sales & Dispatching



Sales & Dispatching

Commodity delivery chain – from raw material to construction site

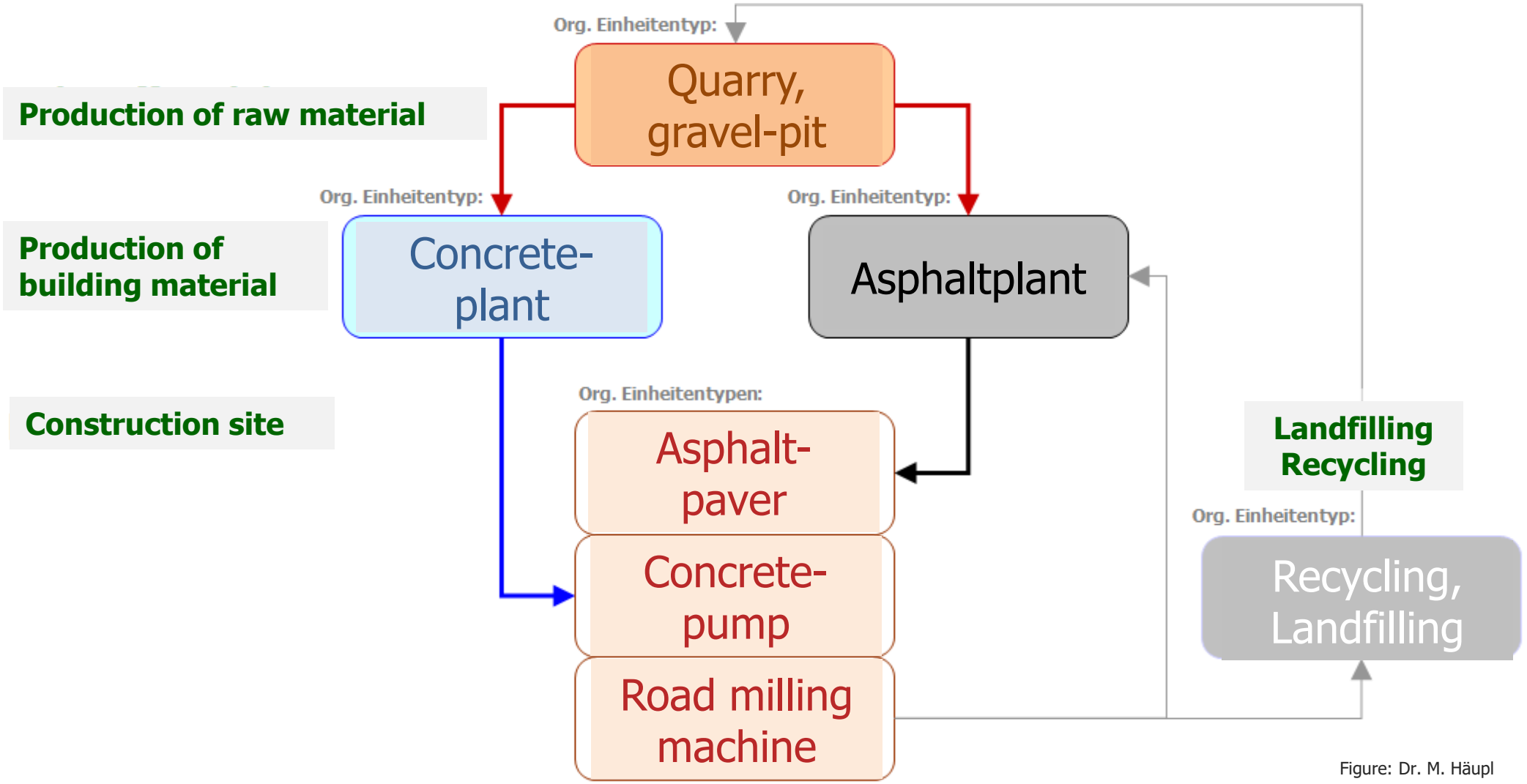
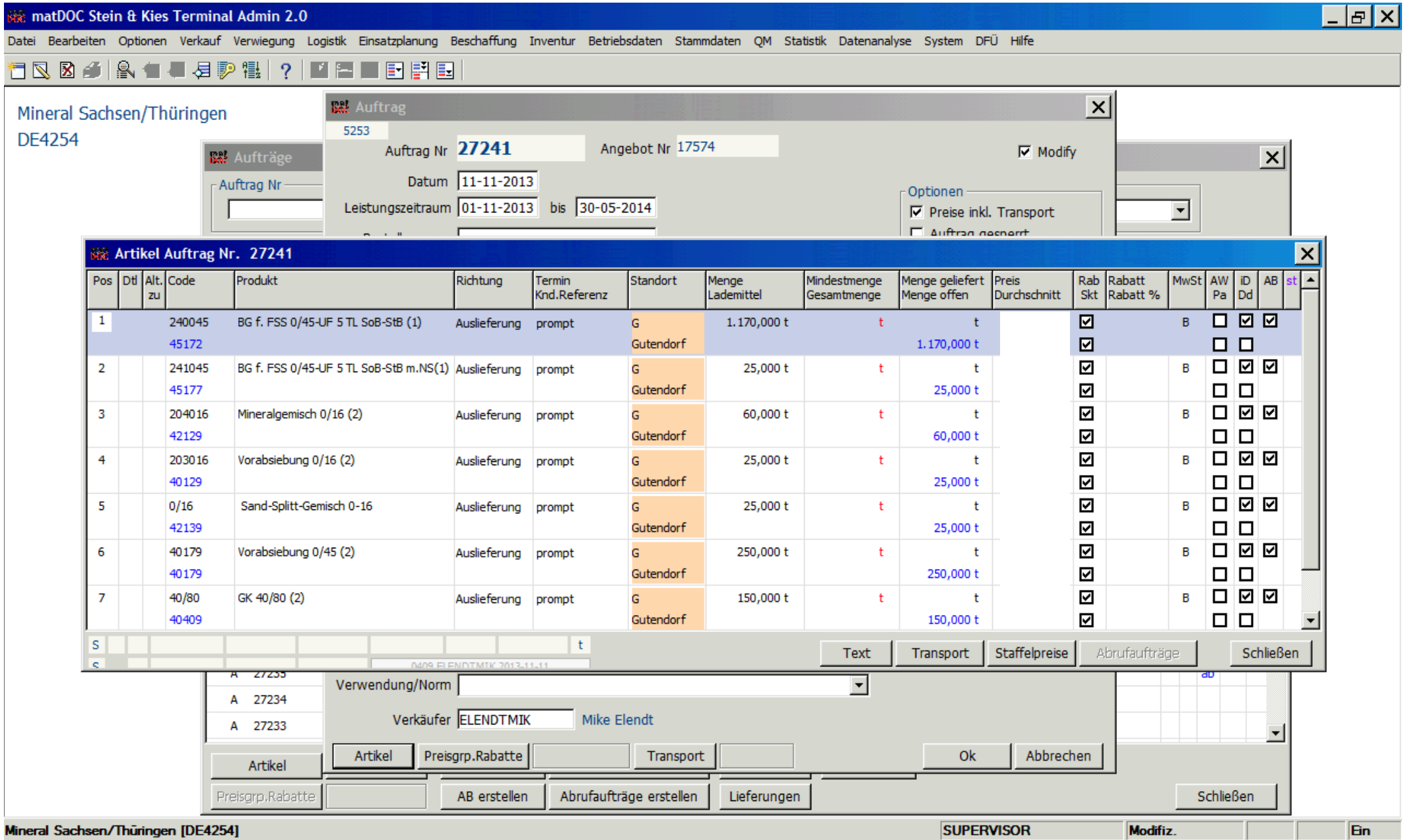


Figure: Dr. M. Häupl

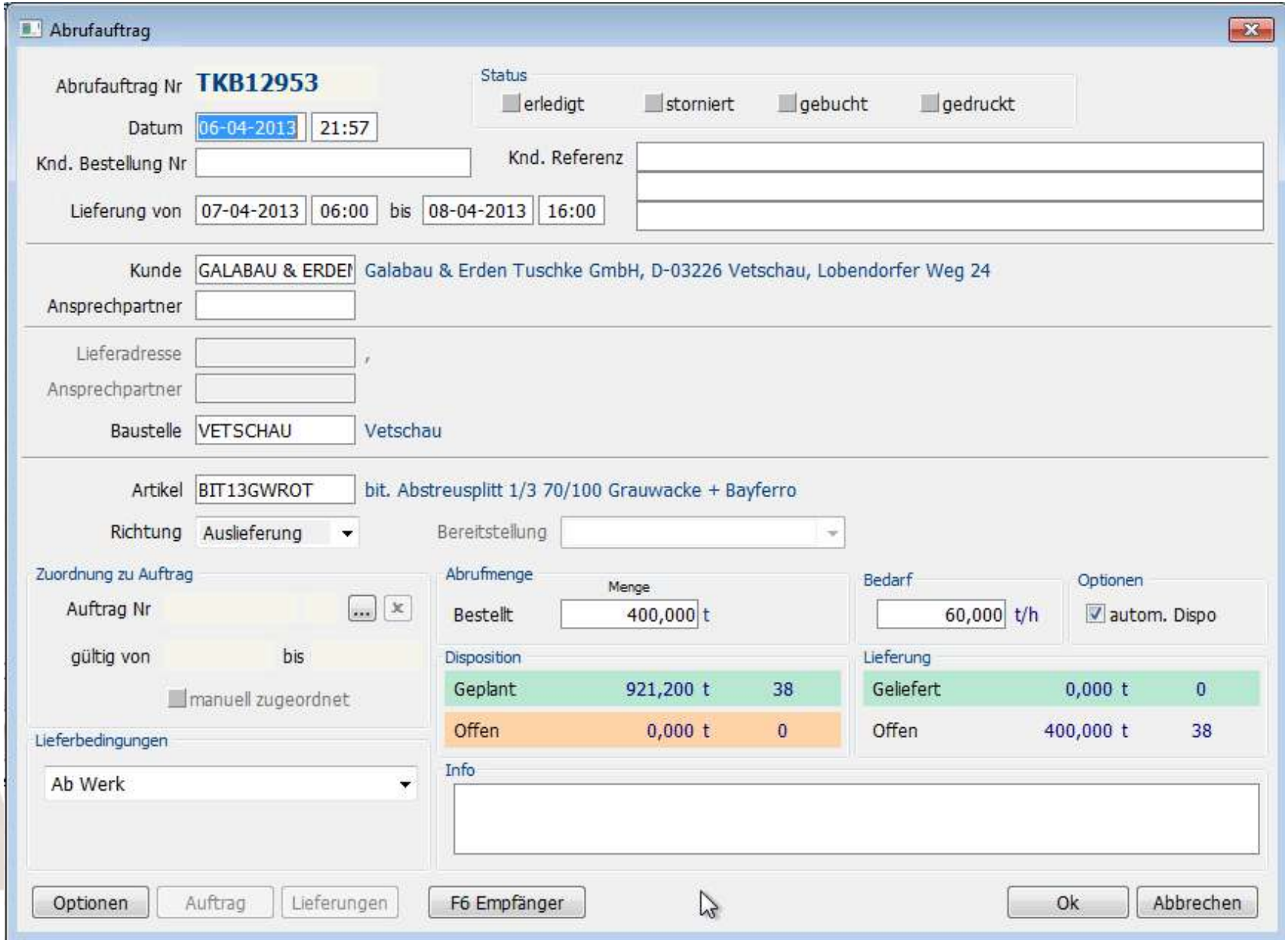
Sales & Dispatching

Sales: Creating of offers / processing of contracts



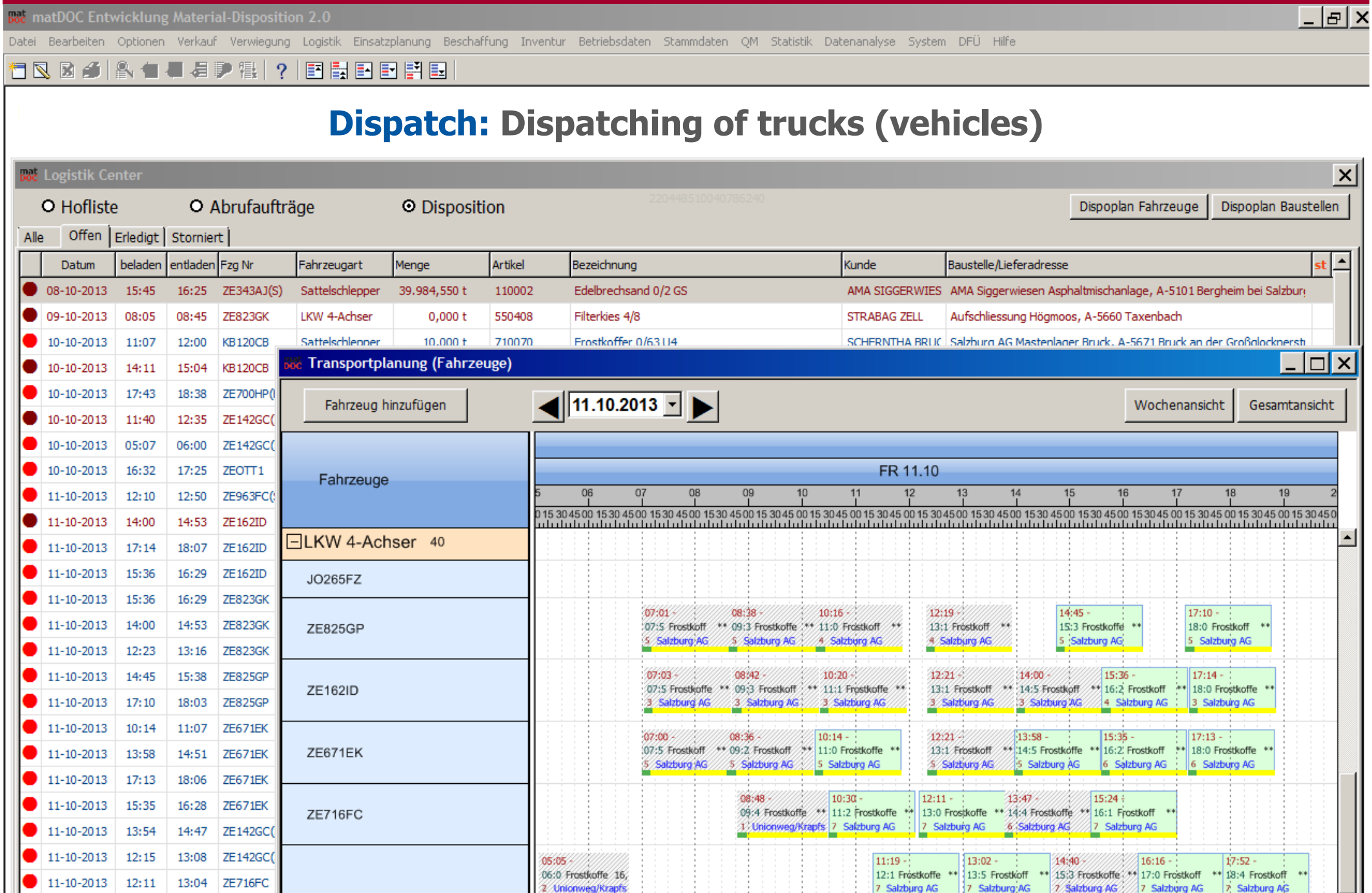
Sales & Dispatching

Dispatch: Processing of call orders



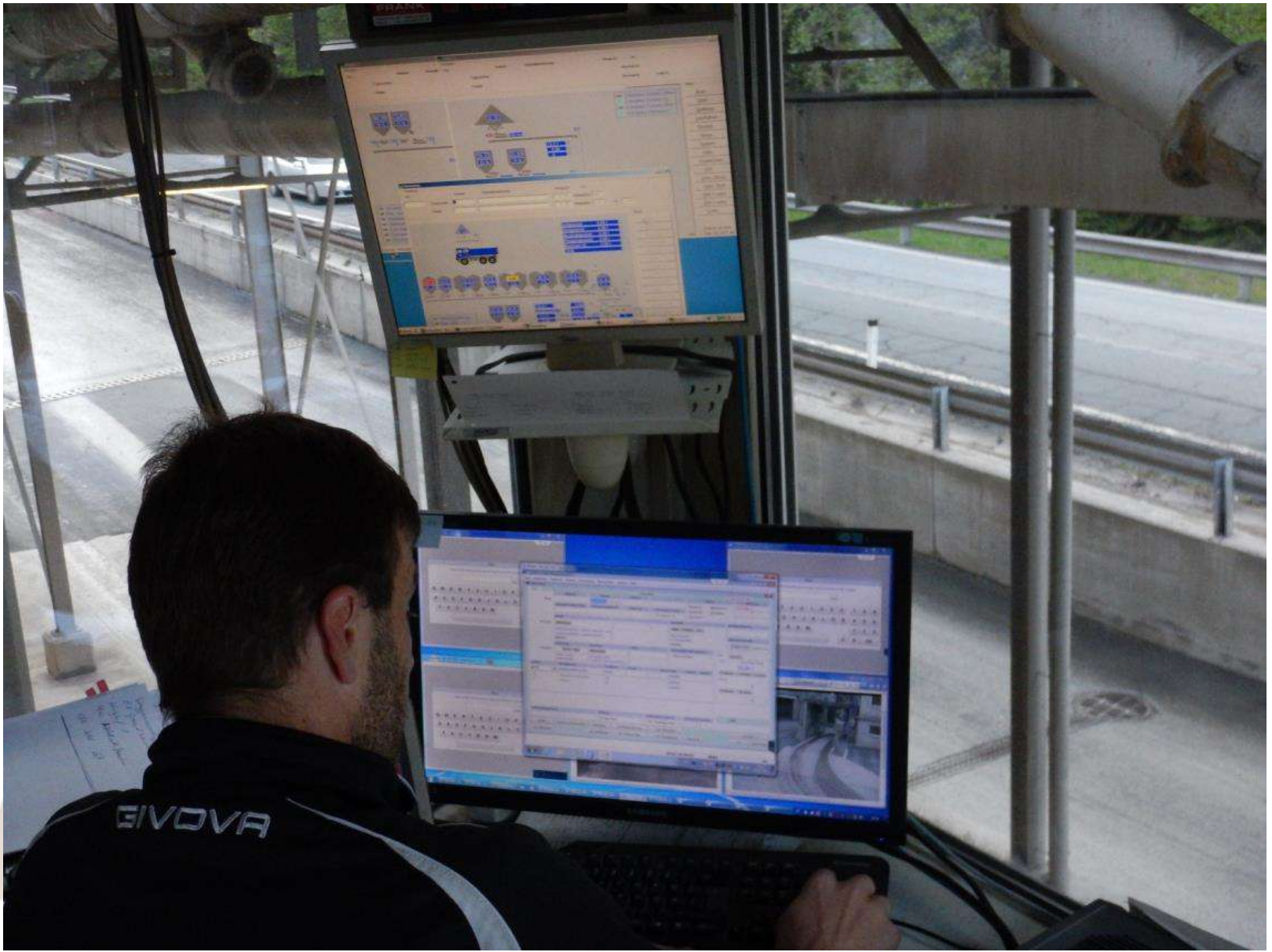
Sales & Dispatching

Dispatch: Dispatching of trucks (vehicles)



Sales & Dispatching

Workplace sales & dispatch



Sales & Dispatching

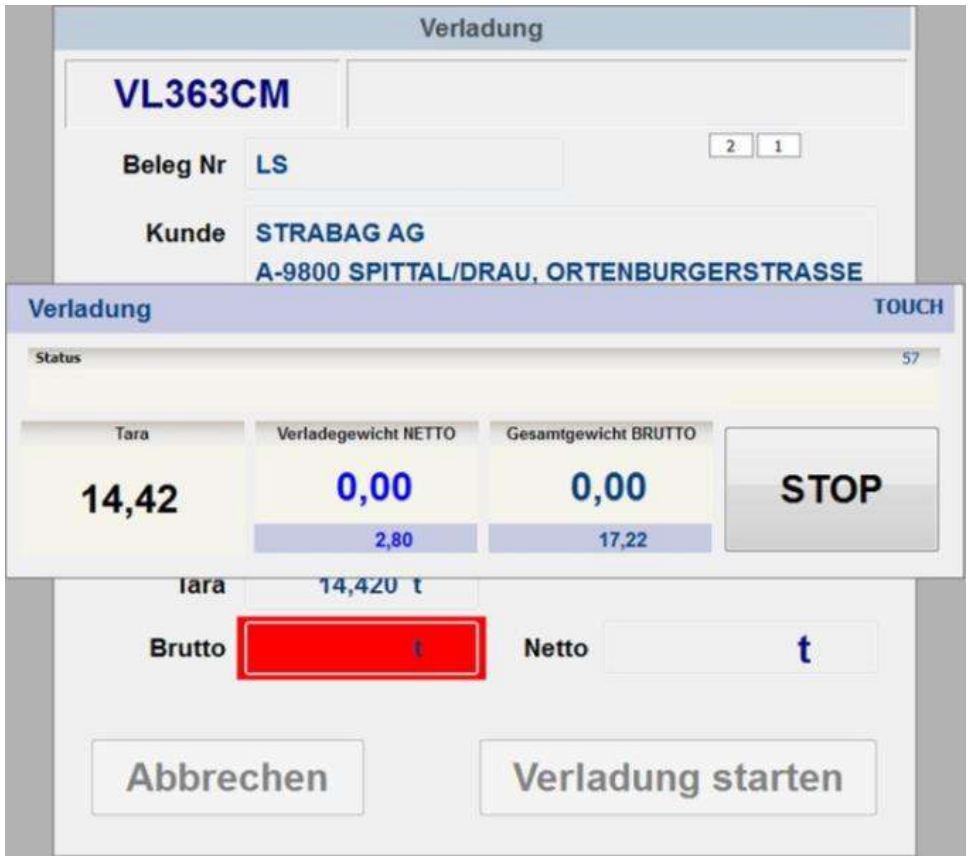
Truck-Selfservice-Terminal: Registration of truck

Sales & Dispatching

Truck-Selfservice-Terminal: Choice of planned deliveries

Sales & Dispatching

Truck-Selfservice-Terminal: Confirmation of delivery and start of loading



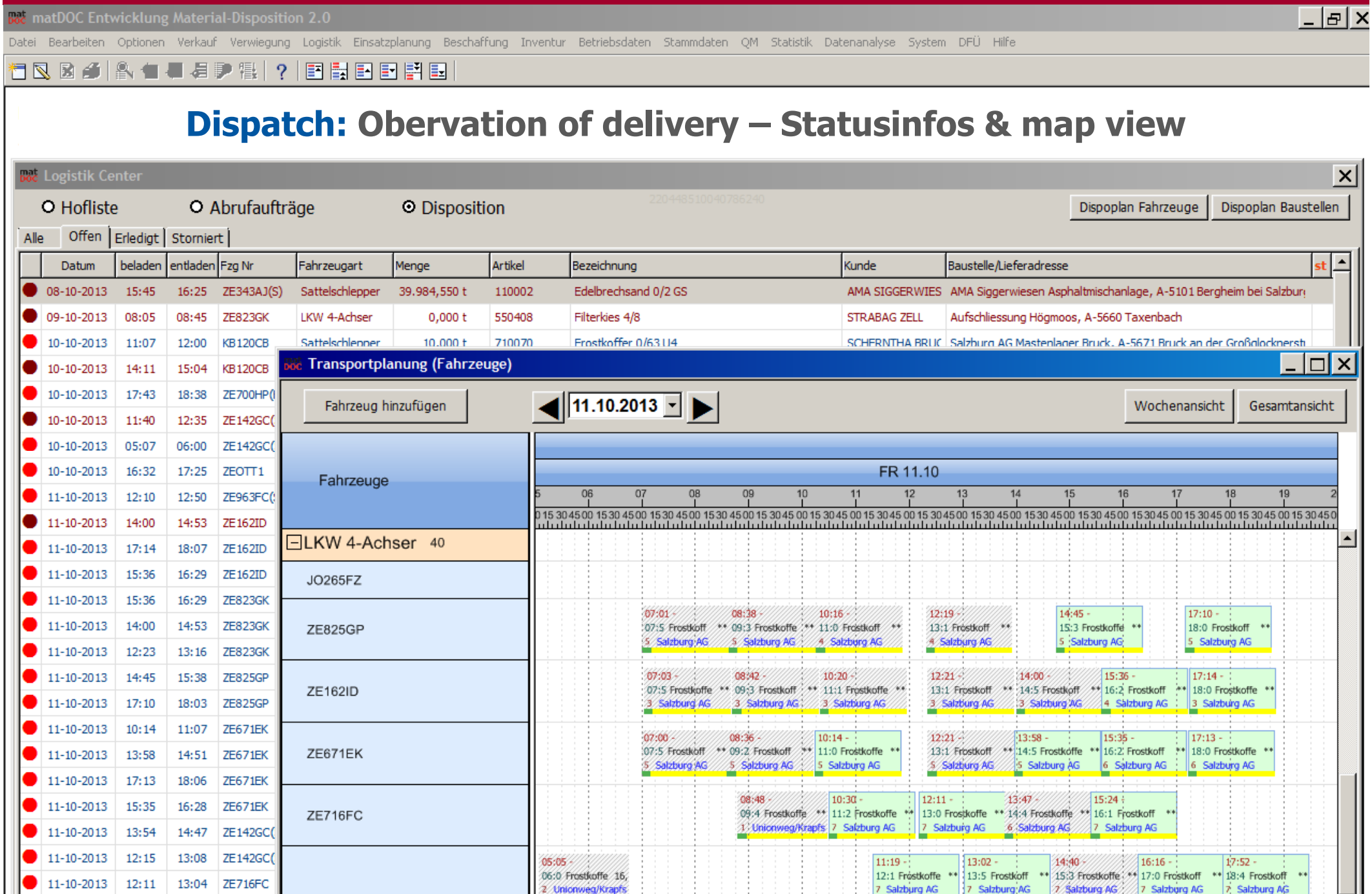
Sales & Dispatching

Truck-Selfservice-Terminal: Closure of dispatch and loading process

- Display of data of delivery notes
- Sign at Touchscreen / Sign-pad
- Printing of the delivery note for truck driver
- Filing of electronical delivery note within the archiv of documents via Adobe pfd-file
- As an option pictures of the loading process may be made (loading area, licence plate, …)

Sales & Dispatching

Dispatch: Obervation of delivery – Statusinfos & map view



Truck-Selfservice-Terminal

6.2 Truck-Selfservice-Terminal

Truck-Selfservice-Terminal

„Office-workplace" Sales, dispatching, delivery notes, accounting

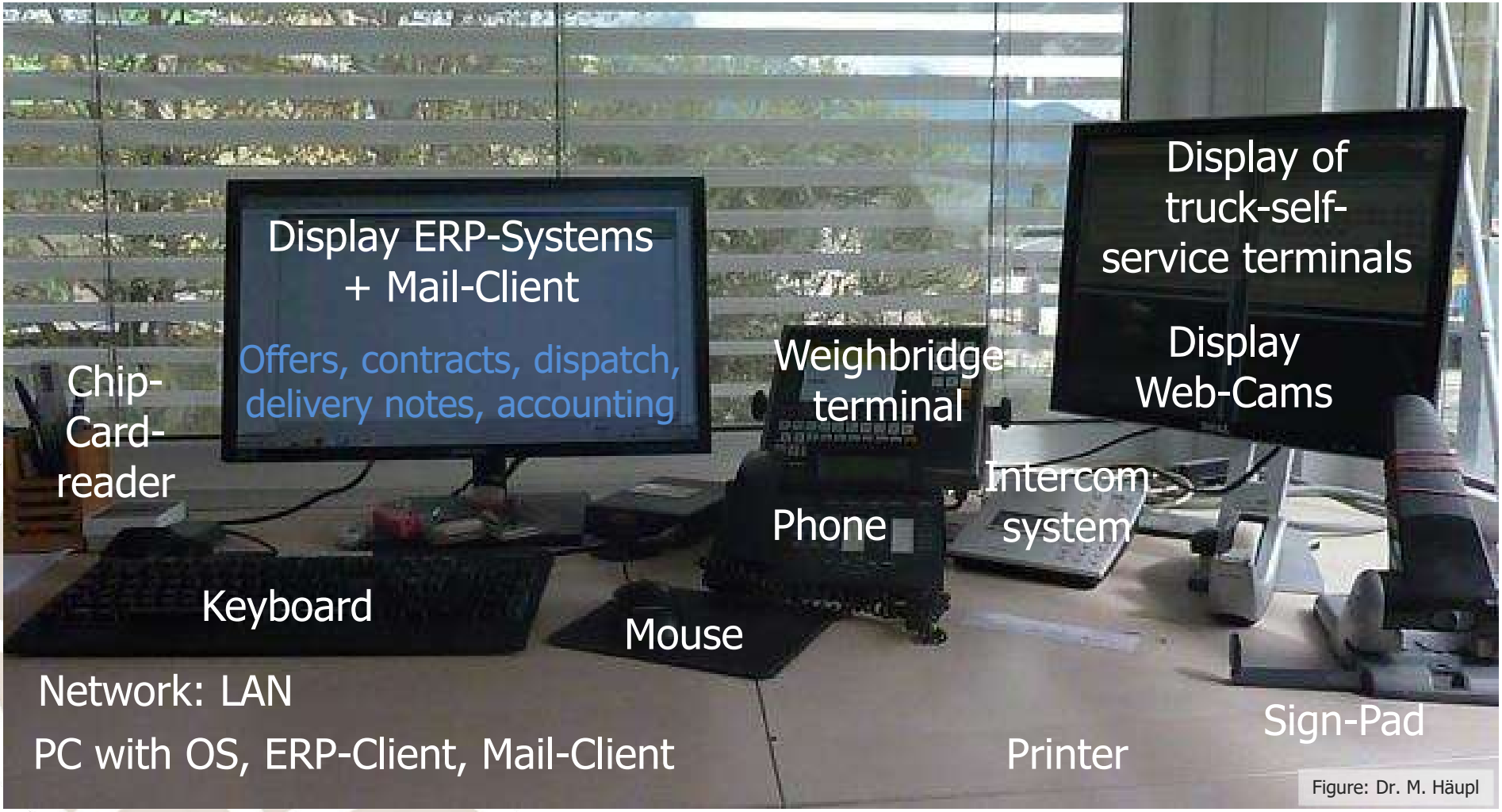
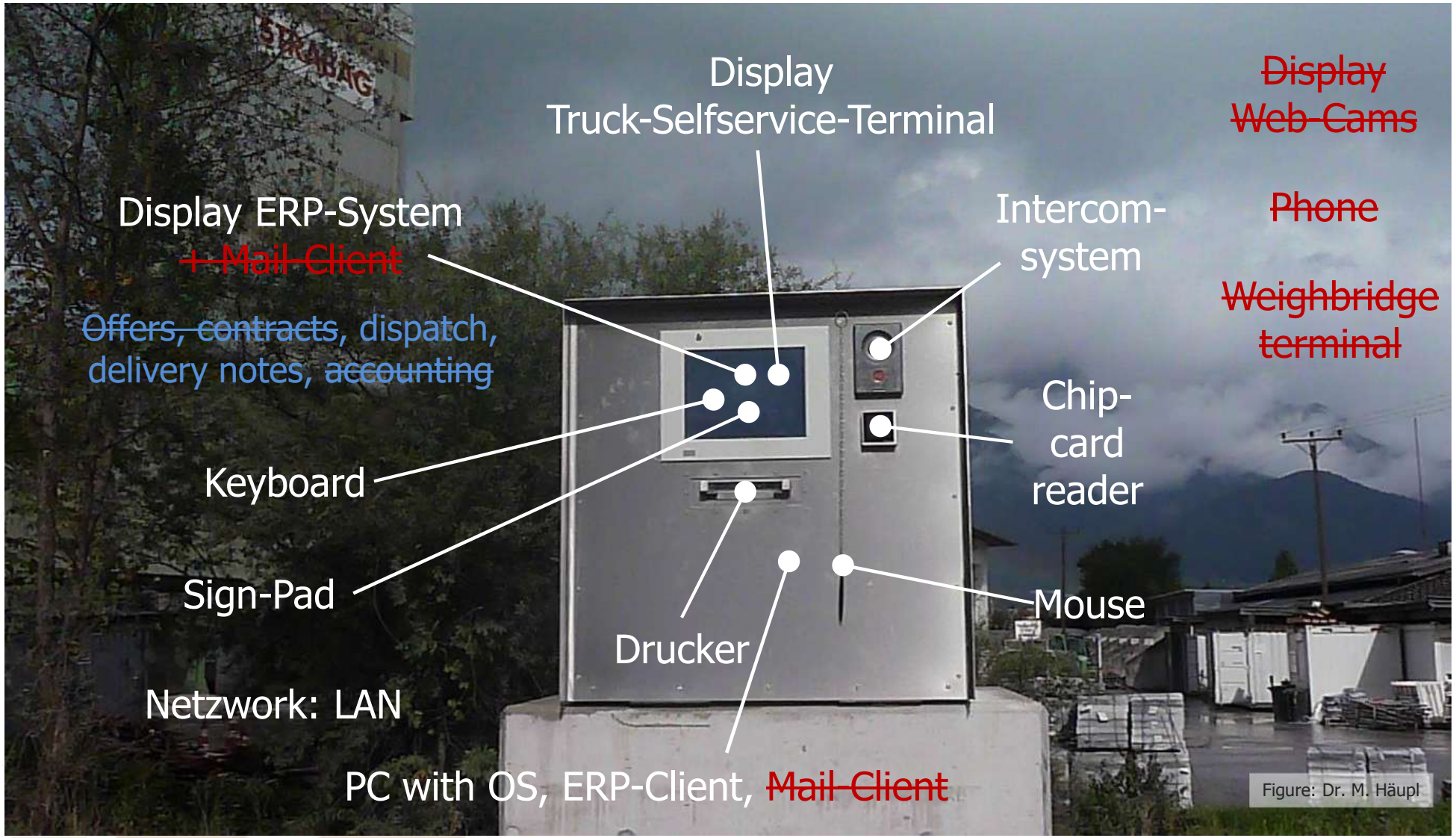


Figure: Dr. M. Häupl

Truck-Selfservice-Terminal

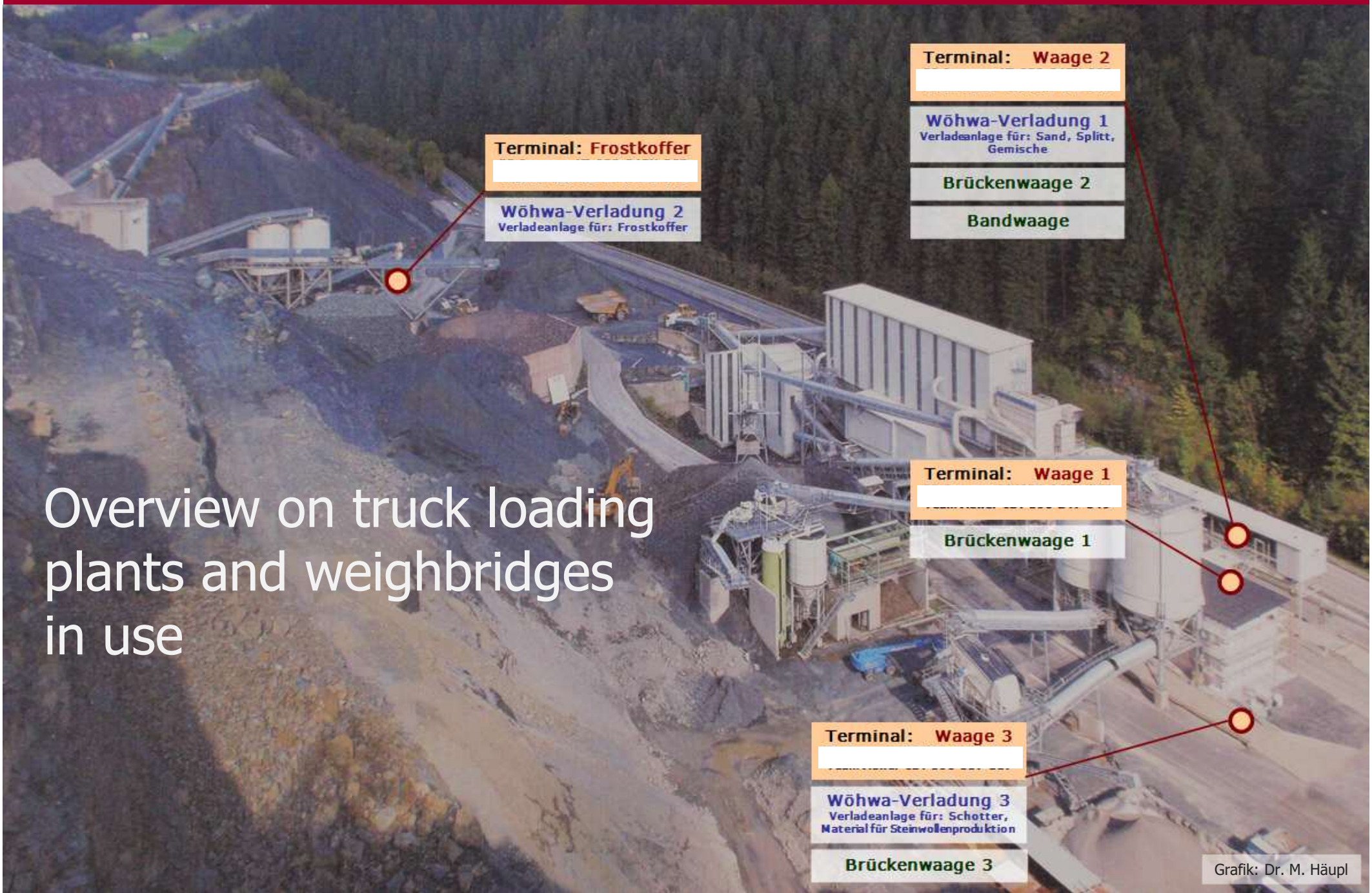
Workplace Truck Selfservice Terminal vs. „Office-workplace“



Truck-loading plant

6.3 Fully automated truck-loading plant

Truck-loading plant



Truck-loading plant

A loading plant has been fully automated:

- Weighbridge (Truck-Targetweight)
- Conveyor scale (material-targetweight)
- Movable Conveyor belt
- Loading nozzle (Minimizing emissions)
- Loadout system
- Truck-Selfservice-Terminal
- Traffic light (Truck-positioncontol)
- Connection to ERP-System

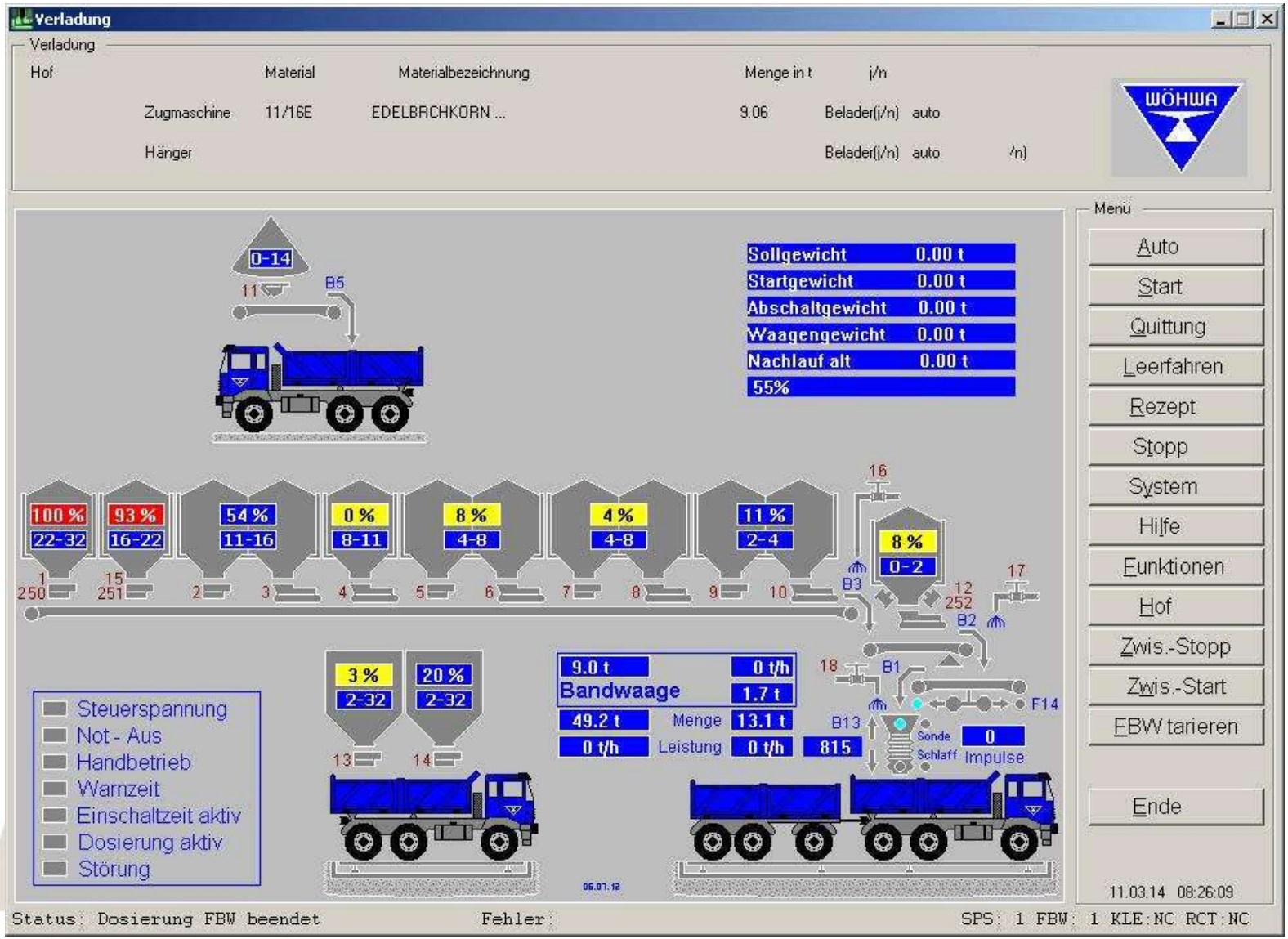
Truck-loading plant

Overbuilt and movable conveyor belt:

- Truck stands still during the whole loading process
- Conveyor belt moves to truck-specific loading position
- Loading nozzle rises and lowers
- Control of material weight via belt scale
- Control of truck weight via weighbridge

Truck-loading plant

Loadout system: Delivers chosen material(-recipe) und controls the loading belt + loading nozzle acc. maindata out of ERP-Sytem



Truck-loading plant

Loading belt + nozzle: Loading happens fully automated

Wheelloader-Terminal

6.4 Wheelloader terminal

Wheelloader-Terminal

„Office-workplace" Sales, dispatching, delivery notes, accounting

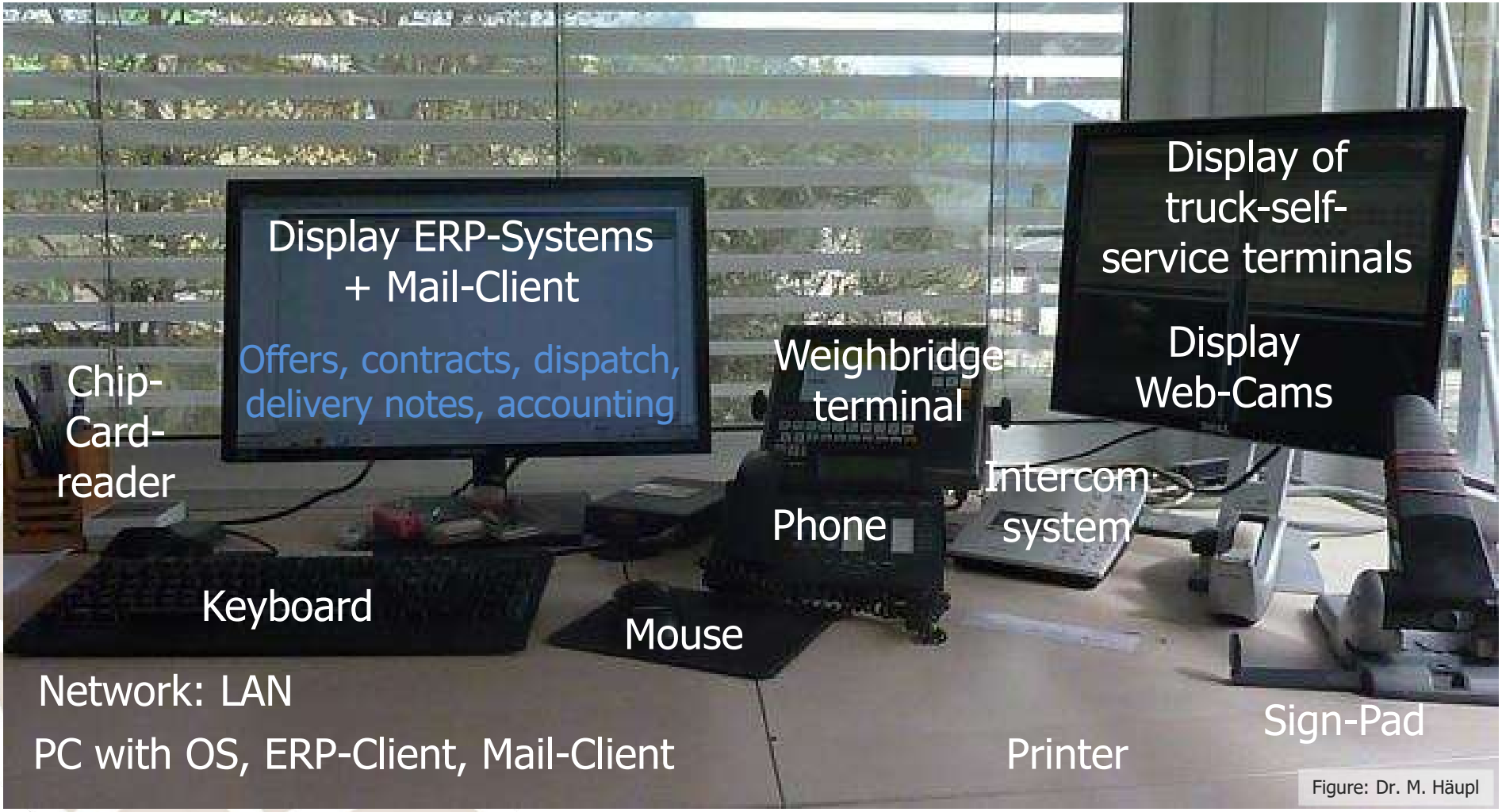
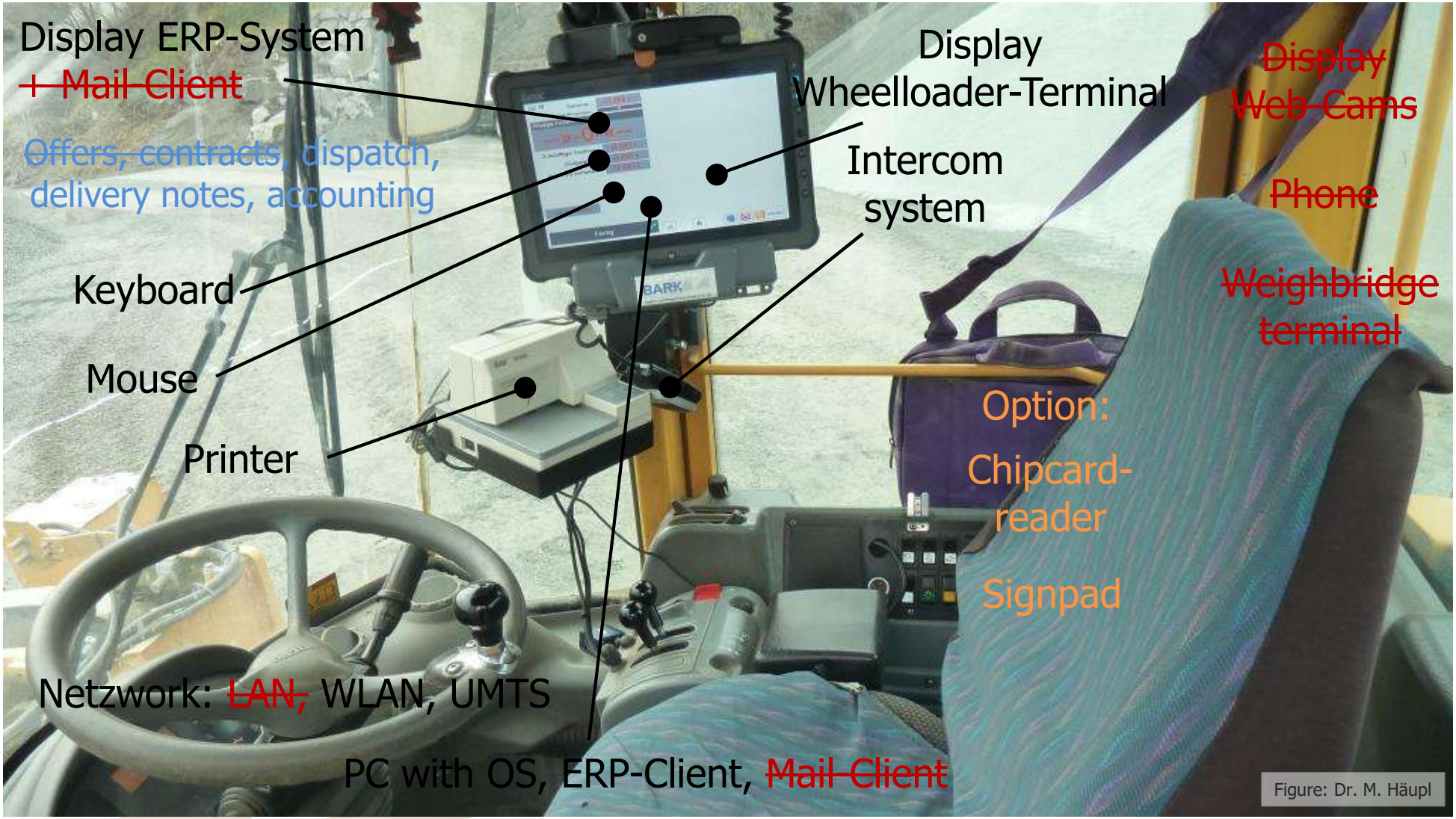


Figure: Dr. M. Häupl

Wheelloader-Terminal

Workplace **Wheelloader-Terminal** vs. „office-workplace“



Management of an open pit mine