Supply Chains and SCOR – the Supply Chain Operations Reference Model

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1 On the Systemic Structure of (Enterprise) Organisations

The systemic understanding of an (entreprise) organisation, which can be read off from the normative documents (APQC-PCF) and practically relevant enterprise modelling (Business TRIZ) examined so far, assumes two systemic levels to be distinguished – operational and strategic management.

From the *perspective of strategic management*, the system is the whole enterprise, divided into strategic business units as components (APQC-PCF levels *category* and *process group*). Reduction to essentials at this level means organising the relationships both between these components and with the company's environment to achieve the *strategic goals*[1]. It is therefore a matter of organising the throughput of energy, material (in the broadest sense, including "human resources" which play a central role here) and information in the qualities, quantities and rhythms required within a specific intrinsically defined time horizon (the "rhythm" of the overall system). This kind of organisation assumes that short-wave temporal fluctuations of the throughput can be intercepted and compensated within the components. Such *resilience* of the components is, of course, a property that in turn must be reproduced at the level of the overall system. APQC-PCF provides here for a company-wide division into 13 *categories* as strategic business areas. These do not have to be formally established or separated within the company, but if a company wants to participate in the cross-company exchange of experience that APQC organises, then these areas must be at least virtually delimitable in the business model of the company.

The focus of *operational management* is on the concrete design and development of these individual business areas at the operational and thus at an intrinsically shorter time horizon. APQC postulates at that level clearly more centralised management structures with corresponding authorisations and rights of intervention, but also responsibilities. On the other hand, it also provides for differently designed intra-company structures through *variants of the standard* at the level of modelling processes, activities and tasks. The standardisation efforts are thus directed at the *strategic structural level* and a certain standardisation of *operational processes in their methodological meta-model* rather than structural model dimension. The latter makes it possible, despite structurally different modelling at the operational level, to organise the comparison between process planning and real-world process execution as

[1] According to previous discussions, I use the term *goal* for longer-term and *objective* for shorter-term targets.

a contradiction between *justified expectations* and *experienced results* in a comparable way by regularly recording *Key Perfomance Indices* (KPI) (see 13.6 *Measure and Benchmark* in APQC-PCF).

This information, collected *globally* at the subsystem level as a component of the overall system, is then used for controlling processes at the subsystem level by operational management. This information is thus part of a *global conceptualisation* for this subsystem level, of a *cooperative world view* as an emergent phenomenon, which is inseparably linked to the development and strenghtening of the structure at this subsystem level. Both individual steering impulses for individual employees (management by objective, management by incentive, ...) and cooperative steering tools (such as the relationships between *Product Owner*, *Team* and *Scrum Master* in Scrum) are used.

Even if the KPIs are modelled and collected globally throughout the company, the possible uses of these instruments remain the same at the operational level, because the authorisation of the operational management is limited accordingly and thus *judgement practices* can be executed only within the subsystem. On the other hand, the KPIs of a globally collected system are not very useful in this level of detail at the strategic management level and must be *aggregated into strategic KPIs* to enable similar judgement practices at the strategic level. Such judgement practices at the strategic level thus strenghten a *strategic worldview* of the company that differs from the worldview at the operational level in the sense of the tension between the general and the special. It should be further noted that operational management enters as control component *subject* (in the sense of TRIZ terminology) at the subsystem level, but is predominantly the *object of control* at the strategic level.

Particularly in agile contexts, in which instruments of indirect control are also used at the operational level, there are often more than two such system levels to distinguish, which can be read off from clearly differing time horizons. In Scrum, for example, the structuring units *Daily Scrum*, *Sprint* and *Product Backlog* or *Project* mark four systemic contexts – the *Project* as a whole as a component of strategic corporate development, the individual *Sprints* as components of the system *Project*, the contents of which are negotiated between the project owner as control component in the *system Project* and the team, and the agile implementation structures in the *system Sprint* by the individual team members as components (or resources?) with, e.g., their progress reports in the *Daily Scrum*. Here, too, the structural design of the *system Sprint* is in the hands of the team; Scrum provides only methodological advice and tools that – if they are used appropriately – enable progress to be monitored "from outside" at the level of the *supersystem Project*, on the basis of which decisions can be made about interventions in the team's self-organisation processes by the control component of the supersystem.

2 Systemic Structures and Agent-based Systems

Most management theories focus on developing methodological tools with which appropriately authorised individual leaders can *implement* externally specified objectives (as a *specification* of a justified expectation) so that the experienced result comes as close as possible to the expectations. Both (specification and result) can be found in descriptions based, e.g., on APQC-PCF as *activity* and *work product*. In this context, management and leadership overlap, as both the employees involved in the process as "human resources" are to be guided

in order to fulfil the operational tasks appropriately, and the emergent systemic resources as *infrastructure*, in particular these "human resources" and the "cooperative world view", are to be maintained and further developed.

Management theories do not say much about how to address the same issues at the strategic level of the company. One of the (non-explicit) preconditions at that level seems to be a certain collective decision-making, since the managers involved represent different operational areas that are all important by their own and thus, in addition to *goals* as justified expectations that can be bundled, the various intrinsic logics of the operational areas enter into the decision-making process as partly contradictory restrictions and thus the reproduction conditions of the components appear as a multitude of (additional) requirements.

A radical answer to this problem is the transition to agent-based systems as presented in the previous week's seminar [2]. A system is built from agents as components whose internal reproduction conditions ("belief, knowledge, desire, obligation, commitment, state, thinking about past actions, learning, (internal) goals" – [2, slide 9]) are decisive for what kind of systems can be assembled from them at all. If one believes the explanations in [2], goals or objectives of an overall system no longer seem to drive the development, but (solely?) the coordination achieved by "communication, negotiation, information sharing" [2, slide 34] among the agents as system components. However, later [2, slide 35] a CEO with "guidance" appears.

Essential "advantages of an agent-based approach in business environments" are summarised on [2, slide 37]:

- Head business management focuses on higher-level decisions.
- Improved problem-solving capabilities through specialisation.
- Improved problem-solving capabilities through mutual support.
- Sophisticated goal-oriented communication.
- Improved physical organisation.
- Outsourcing of cross-cutting concerns.

Hence, other aspects than the seeming ability of agents to act autonomously and the assertion that a separate optimisation of the agents leads to optimality of the overall system come to the front. These are primarily "beliefs" and "knowledge" as two properties of an *emergent system-specific conceptual system* – a "cooperative world view" – which allows to capture in language form the specific "reduction to essentials" of the system-internal relations between the components. In an agent-based approach the unfolding of such a conceptual system, called "schematisation" by Shchedrovitsky [3], is postulated for the agents as components. But it must also *unfold at the level of the system.* The temporal offset of the unfolding of conceptual systems at different levels is an essential characteristic of dynamics in systemic structures. In view of the reduction of the component properties to their specification, the conceptual systems of the components enter into this new systemic conceptual system only in a reduced form, but must be expanded by conceptualisations and modelling approaches for the essential interactions between the components.

3 Agent-based Approaches as a Model of a Market-based Landscape of Independent Producers

Agent-based systems model a basic assumption of the free market concept – the contract-based action of economic subjects as homines oeconomici optimising private benefits leads to an optimal overall economic system. The "blind hand of the market" and thus the "naturally" occurring economic processes (TRIZ Principle 25: By itself) lead "behind the market participants" in most cases to better results and are superior to regulatory interventions in these processes. This belief is in apparent contradiction not only to the importance of institutionalised procedures as pillar 2 in the 3-pillar concept of technology developed in the lecture, but also to all *practical* efforts to standardise business processes, which were addressed in the two previous seminar presentations (APQC-PCF and Business TRIZ).

As explained above, the efficiency of the "blind hand of the market" is essentially linked to the development and unfolding of elements of systemic structures and related conceptualisation processes. Production based on the division of labour is only possible if this division of labour is embedded in overarching institutionalisation processes, in the framework of which communication based on common conceptual systems accompanies real-world cooperative action, especially the exchange of labour products and services between independent third parties.

Hence agent-based approaches represent an important field of gaining experience for precisely such institutionalisation processes, if the corresponding systems are regarded as systems in development that are still in an early phase of interaction networking. *Digital* agent-based systems are a particularly interesting field of experimentation in view of their easy modifiability. Gaming approaches in this field recently received particular popularity.

4 Supply Chain Management

The exchange of products and services across company boundaries is not only oriented towards the induced money flows, but also towards the material properties – the *use value* – of the exchange products. The more detailed the corresponding conceptual systems for qualitative and quantitative parameters of the exchange products are developed, the more precisely these use value can be described. Today such cross-company conceptual systems are already well developed in many domains and make it possible to trace the origin and quality of work products and their ingredients over longer supply chains.

In the course of modelling business processes within a company not only the *product quality* of individual commodities that enter the company as resources is of interest, but also the more comprehensive possibility to assess the *quality capability* (process quality) of economic partners. This quality capability of a company does not necessarily mean that *all* its products are of high quality, but in addition to the average high quality of the products, adherence to delivery dates, costs and service within narrow predictable ranges can be expected. Supply chain management focuses on such issues of assessing quality capability in supply chains.

5 SCOR – the Supply Chain Operations Reference Model

Similar to APQC-PCF, SCOR as a *reference model* systematises the essential aspects that have to be considered in a structured way during such an assessment of partners in the supply chain. SCOR 1.0 was released in 1996 and has since been developed in various versions. Today, the further development of SCOR is coordinated by the ASCM Foundation – the *Association for Supply Chain Management*.

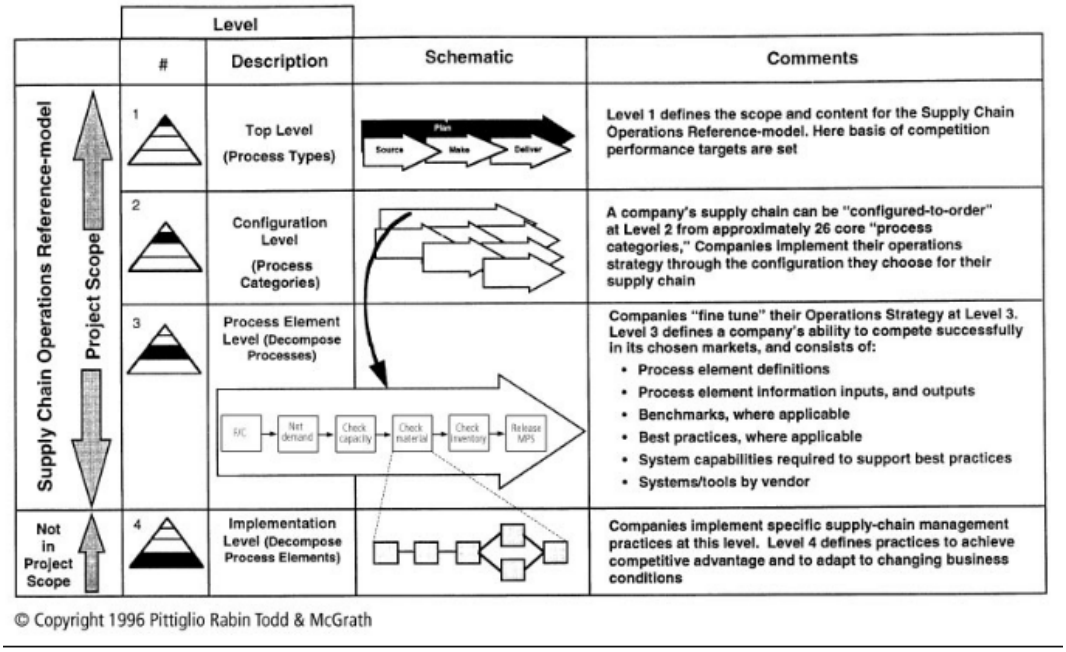
Peter A. Bolstorff writes on the SCOR history on the ASCM blog [1]:

> My journey with SCOR began when I was a delegate from 3M (and then its spin-off Imation) as part of the launch of SCOR 1.0 in 1996. [...] At the time, we needed to define key **performance** indicators that balanced customer requirements with internal capabilities; architect **processes** to leverage the technology; adopt **practices** that were more than just white papers; and develop **people** to have both the knowledge and skills to make it all happen and move the needle of performance and achieve the promised ROI.
>
> [Today] over 5 000 companies have leveraged SCOR as part of their supply chain excellence journey. Innovations in each of the 11 versions of the reference model were driven by practitioners challenged with having to model the future while delivering business value in the present. We're now three years into the APICS and Supply Chain Council merger and our practitioner community is once again sorting out how to innovate SCOR to model a faster set of changes enabled by amazing technology advancements – all the while delivering quarter over quarter results.

The following essential structural elements are taken from [4] and represent the status of 1997.

SCOR as the standard process reference model for supply-chain management brings order to the diverse activities that make up the supply chain, and provides common terminology and standard process descriptions. The model allows companies to:

- evaluate their own processes effectively;
- compare their performance with other companies both within and outside their industry segment;
- pursue specific competitive advantages;
- use benchmarking and best practice information to prioritise their activities;
- quantify the benefits of implementing change; and
- identify software tools best suited to their specific process requirements.



The four level model of SCOR as displayed in [4]

SCOR features four levels of supply-chain management:

- **Level 1** provides a broad definition of the plan, source, make, deliver process types, and is the point at which a company establishes its supply-chain competitive objectives.
- **Level 2** defines 26 *core process categories* that are possible components of a supply chain. A company can configure both its actual and ideal supply chain by selecting from these core processes.
- **Level 3** provides a company with the information it needs to plan and set goals successfully for its supply-chain improvements through detailed process element information for each level 2 category. Planning elements include process element definitions, diagnostic metrics, benchmarks, best practices, and system software capabilities to enable best practices.
- **Level 4** focuses on implementation, when companies put specific supply-chain improvements into play. Since changes at level 4 are unique to each company, the specific elements of the level are not defined within the industry-standard model.

SCOR focuses on four basic supply-chain processes:

(1) **Plan:**

- *Demand/supply planning:* Assess supply resources; aggregate and prioritize demand requirements; conduct inventory planning; assess distribution requirements; determine production, material, and rough-cut capacity for all products and all channels.
- *Plan infrastructure:* Make/buy decisions; supply-chain configuration; long-term capacity and resource planning; business planning; product phase-in/phase-out; manufacturing ramp-up; end-of-life management; product line management.

(2) **Source:**

- *Sourcing/material acquisition:* Obtain, receive, inspect, hold and issue material.
- *Source infrastructure:* Vendor certification and feedback; sourcing quality; inbound freight; component engineering; vendor contracts; initiation of vendor payment.

(3) **Make:**

- *Production execution:* Request and receive material; manufacture and test product; package; hold and/or release product.
- *Make infrastructure:* Engineering changes; facilities and equipment; production status; production quality; shop scheduling/sequencing; short-term capacity.

(4) **Deliver:**

- *Demand management:* Conduct forecasting; plan promotions; plan projects; plan sales campaigns; collect and analyse point of sale (POS) data and actual customer orders; promote products; price products; measure customer satisfaction; execute efficient customer response (ECR).
- *Order management:* Enter and maintain orders; generate quotations; configure product; create and maintain customer database; manage allocations; maintain product/price database; manage accounts receivables, credits, collections and invoicing.
- *Warehouse management:* Receive and stock finished goods; pick and pack; configure products; ship products; create customer specific package labelling; consolidate orders.
- *Transportation management:* Manage traffic; manage freight; manage prod-uct import/export.
- *Installation management:* Schedule installation activities; perform installation; verify performance.
- *Deliver infrastructure:* Channel business rules; order rules; management of deliver inventories; management of deliver quantity.

References

[1] Peter A. Bolstorff (2017). 20 Years of SCOR: Reflections on Relevancy and the Road Ahead. ASCM Blog, 03/27/2017. `https://www.ascm.org/`

[2] Stefan Härtel (2021). Slides to his talk on November 16, 2021. Available in the github repo.

[3] Georgi P. Shchedrovitsky (2014). Selected Works. A Guide to the Methodology of Organisation, Leadership and Management. In: Khristenko, Reus, Zinchenko et al. Methodological School of Management. Bloomsbury Publishing. ISBN 978-1-4729-1029-5.

[4] Gordon Stewart (1997). Supply-chain operations reference model (SCOR): the first cross-industry framework for integrated supply-chain management. Logistics Information Management, vol. 10 (2), pp. 62–67.