

DANGEROUS GOODS LOGISTICS

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Abstract: The logistics is a segment of opportunities for solving different kinds of tasks for industry (minimizing cost, increasing of flexibility, productivity grow etc.). Dangerous goods transportation is very sensitive in task of safety. Many factors can have influence on total stability of supply chain of dangerous goods. Some moments aren't returnable so the dangerous goods logistics must be prepared for problems which can happen. This is the area for supply chain optimization with focusing on risk elimination.

Keywords: LOGISTICS, RISK, DANGEROUS GOODS, TRANSPORTATION, SUPPLY CHAIN

1. Introduction

Logistics has four main aspects. Required quantity at required time to the right place in correct quality and that's all for appropriate remuneration. If something get damage during the transportation carrier doesn't abide the quantity, if that requires another transportation that breaks the plans and increasing the costs. If carrier insures with higher quantity for every transport, he waste sources, customer capacities, strains own capacities – vehicles, loading spaces, infrastructure, loading times, packaging (time and material), labeling, handling etc. If carrier delivery required quantity but the transportation underway other than goods required condition (microclimate - temperature, humidity...), that delays following processes or destroy the shipment. That means failure in question of quality. All those aspects decrease goodwill of the company in consequence of decreasing the competitiveness. Finally that does can evoke increase of prices for end customer in case of fines, penalties or cost increasing by reason of accidents and failures. Dangerous goods transportation induces direct threat in nearest surroundings of transportation routes or much more dangerous the environmental pollution for long time period even for places situated far away from place of accident (due wind or water influence (rivers, groundwater...) etc.). Such irresponsible behavior may be subject to acute, temporary or permanent traumatic conditions requiring a financially difficult diagnosis and therapy. It all comes from the public purse. Prevention is essential in this case. Safety is on the first place. Therefore that exist an enormous number of conventions, codes, regulations to eliminate the risk of such shipments to the minimum possible level. On the other hand, it is necessary to recognize that the dangerous goods are an essential part of our lives and give us a wide range of useful applications, it is therefore necessary to look for ways that leads to lower costs, but not at the cost of reducing safety or quality, but maintain the availability of these commodities to support economic growth in all

countries, either directly or by supporting inputs for different sectors of the national economy.

2. Main tasks for dangerous goods logistics

Dangerous goods supply chains don't start with raw materials but in reach scientific laboratories or test rooms. It's for this reason that every aspect of the supply chain must be safe (mining, production, transportation, handling etc.). Every single member of the supply chain, whether carrier, packager etc. is only a mediator precise instructions of scientists verified and recommended the proper and safe processes. That's creates a hypothesis of requirements of special workers, companies etc. Every type from wide range of dangerous goods list need special conditions and special dealing. The best would be if there were only specialist carriers for each commodity with special equipment. However there is a usage capacity problem, if consignor hasn't got large enough volumes the carrier can have transport efficiency problems. Transport companies performing efficient transportation often got problems in cases of safety requirements. That should ensure safety advisors who have an obligation to be establish. Not often safety agenda and transportation agenda has an ideal pervasion. The reasons are apparent because the transportation is most efficient when majority time of the vehicle life cycle is loaded. Under condition of maximize of lifetime and simplicity of each components (minimize the time for maintenance and shutdowns in case of failures). That can be achieved just at the base of vehicle universality offering transportation for heterogeneity commodity in different kind of transport variants. And yes the ideal solution model is modular logistics system without limitation in usage of transport means. In order to meet these demanding requirements should adhere to the principles of logistics chains to serve the methodology shown in Figure 1.

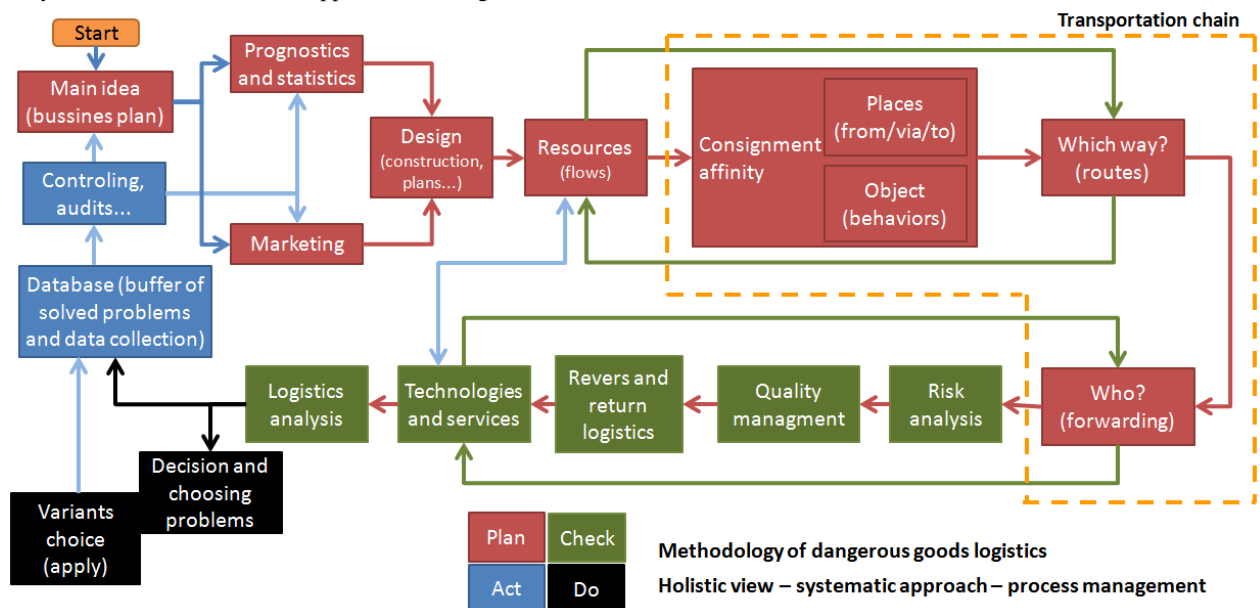


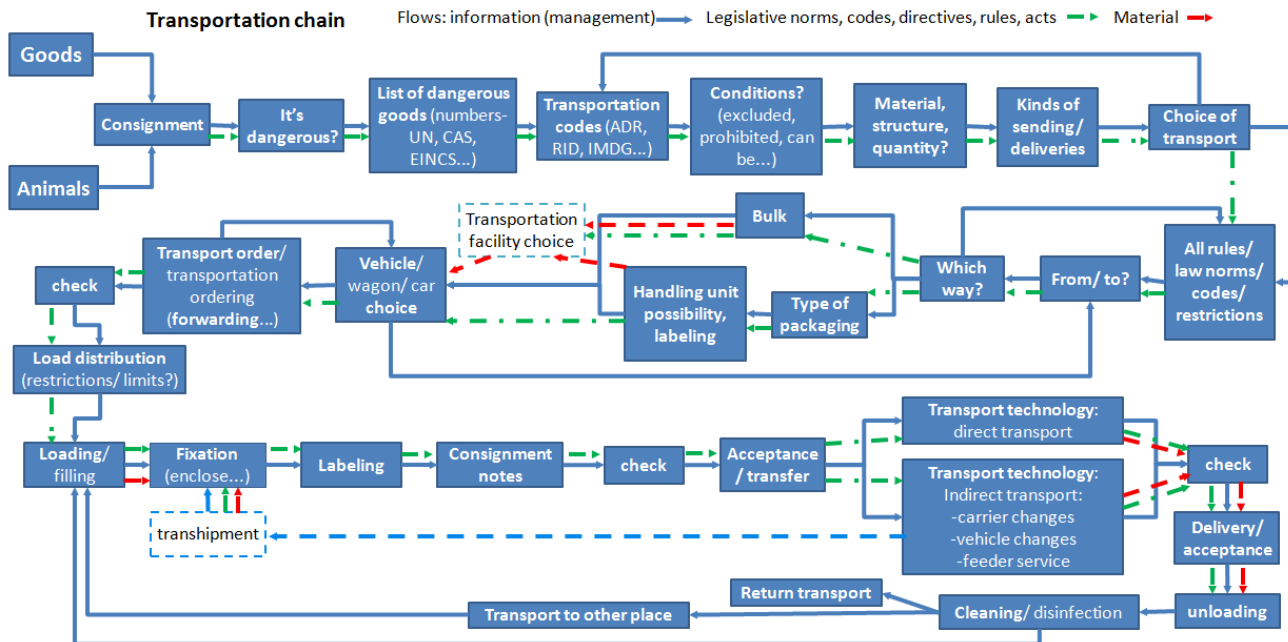
Fig. 1 The methodology of dangerous goods logistics.

Source: authors

3. The methodology of dangerous goods logistics

Seeing that the methodology is shown for general usage, for our case – dangerous goods transportation we must focus on transportation chain (Fig.2). Every supply chain has three types of flows – materials (physical), information and finance (non material). It's very important to properly define and draw-in to the process map. After that the next step is analysis of information flow (management, control etc.), legal (if all operations are carried out in accordance with applicable standards) and physical (from this flow we can calculate value adding of transportation – time consume, failures, costs for each unit of material, goods etc.). At this base we can draw finance flow (but in our context is this information negligible. Usually supply chain start by commodity recognition. The general diversification of the commodities is to the live animals and goods. For our case we eliminate the condition of live animal

we remain gradual selection. Option about bulk loaded just on the vehicle or loaded on the transportation unit (ITU - intermodal) with most effective vehicle or ITU proportion to the goods requirements. Last choice problem is about forwarding manner. Forwarder make usually choice in question of quality of transport, carrier reliability, transport cost etc. If everything is correct all choices and checks are done then comes the material flow (loading, fixating, labeling, handling etc.). From this point it's all about carrier's efficiency in case of transport (traffic) technology. Acts like train formation, traffic control, technical checking, driving style etc. In keeping with the agreed rules can finish the transportation at the required place - a destination, mutual acceptance and delivery of shipment - checks and so on. After unloading the transportation is completed. The following processes can be cleaning tasks and returning the vehicle or re-loading.



and some goods from group of extraordinary shipments (heavy, oversize etc.). So now we can analyze if our object is dangerous. There s only one way how to do it, all hazardous substances, materials, goods are registered in different kind of databases. If it's in one from the databases, registers etc. we can classify it as dangerous. And all dangerous materials, goods has own material safety data sheet - MSDS (or Safety data sheet – SDS). Every producer or manufacturer must issue MSDS under uniform structure – point no. 14 – transportation information is a key factor for transportation. There are listed information about safety transport for all modes of transport usually under united national code and abbreviation of the rule (example ADR/ RID 1203). If transportation can't be safe than can be this type of transportation prohibited. The next step is finding the right rule and UN code in code list. All information about safety transport for each type of transport is listed in tables. What is very important are data about packaging, labeling, pressures, separation or segregation for each material and also information about other size conditions for transportation. All this rules has direct impact for the future planning of transportation. The next problem is about places – from/via/ to. This information can judge how transportation can definitely looks like (key factor). If there are not other restrictions like time pressure for loading, loading restrictions, ramps, cleaning or filling equipment, than is another problem – tracing. In dangerous goods tracing there are several types of restrictions on infrastructure not only traffic (jams, road quality...) or transportation parameters (bridges, tunnels, buildings...) but also restrictions for no entry for vehicles carrying dangerous goods to the country or locality or section of the road, track etc. And the last type of restriction is safety hazard (look next chapter). After all those factors which have direct impact we got one problem choosing one of the options that

Fig. 2 The transportation chain.

Source: authors

4. Risk elimination

As we have mention before solutions for creating or solving the supply chains the main factor that needs to be solved is rarity of goods (the transportation problem). During dangerous goods transportation is very important to be prepared for questions about different kind of risks. There are so many types of dangers, hazard or risk that can endanger supply chain stability. At following figure we define 8 type of danger which common company can face with. The next text outlines the most common dangers focused on human protection, and also usual ways of dealing or elimination to the lowest allowable risk limit.

Safety – environmental protection (ISO 14 000) – it's not only about ecology (green gas elimination, noise or vibration elimination etc.), but it's also about protection from undesired leaks of dangerous materials to the environment (air pollution, water pollution, waste disposal etc.). This type of danger is serious problem to the future environmental changes from habitable to the uninhabitable it's about inconspicuous small rations in long term ingestion and also together with using sources.

Safety and security – perpetration for crisis situation – evaluate and identify expected problems (what to do if..., and other analysis) - collision, failure, incident etc. - periodic information, training, inhabitants' exercises, employee exercises etc. Security system preparation, improving of alarms and detectors, preparations and trainings of special forces (firefighters, emergency rescue systems etc.), effective escape ways, fire protection equipment deployment, marked and visible escape corridors even under bed coordination

conditions (heavy dense smoke, fire...) – daubs, labels, emergency light.

Health and safety at work (ISO 18 000) – safer material handling, elimination of direct exposition on the people by hazardous materials, safety features, first help equipment deployment. Work place preparation for incidents (outflows, fire etc. – safety vat (tube etc.), hermetic closable areas, fireproof daubs, fireproof doors, extinguishing system, air or water screen etc.).

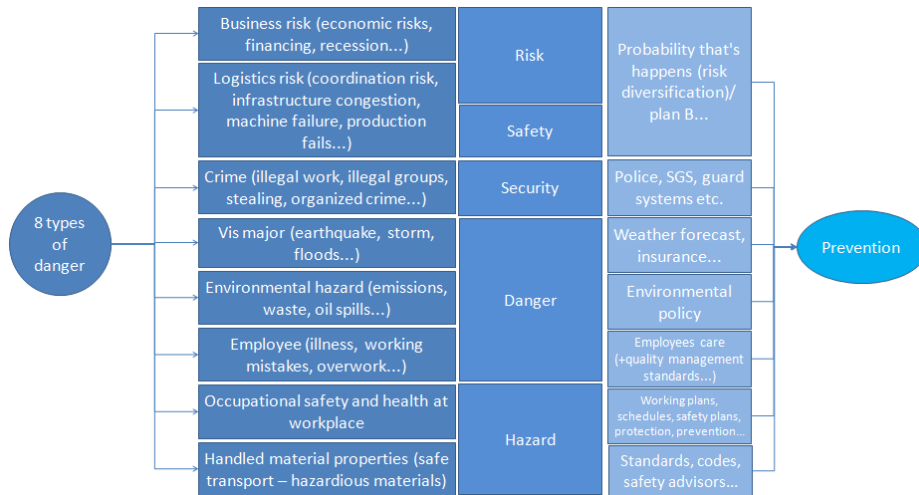


Fig. 3 The scheme of 8 type of danger. The first column describes general areas of risk and dangers. The second column describes topic and the last one describes the possibilities of the prevention.

Source: authors

Safety and quality work – eliminate the work processes difficulties – elimination of staff direct intervention, automation, self detection, self failure detection and signalization (autonomization, JIDOKA), total planning maintenance, revisions, cleaning, layoffs, better planning this processes to production plans (Heijunka) etc. The working stuff doesn't have to watch machine work but just finding a solution of problems (cause detection of machine failure – going to the source – Genchi genbutsu) – in order to avoid unnecessary downtime while waiting for troubleshooting, respectively, to prevent the occurrence of the incident. For example use element like andon signaling to stop all processes in the removal of the situation (leading to changes immediately to coordinate all workers present in the endangered zone).

Safety at workplace – making of Gemba (direct allocation of workplace – workers sector – responsible place) and implementation of KAIZEN's 5 S grows workers performance, in case of elimination of unnecessary activity and also cleaner and tide workplace eliminates risk of getting hurt. Thinking people system implementation gets a real potential for never-ending improvement that's means elimination of unnecessary work, process reform, quality improvement, working efficiency, constrains elimination and risk and danger elimination to the minimum. All this activities need a system of standardization to confirm already existing quality level. What's very useful is poka-yoke technique (mistake-proofing). This technique eliminates failures from inattention of human and prevents disaster. It's part of JIDOKA philosophy. Poka-yoke prevents machine from failure and protect people from failure machine work (machine incident). People working in poka-yoke don't waste their time for concentration on repetitive activities and they can focus on important work (muda philosophy). MUDA-MURI-MURA is very useful for people, because they can be much faster implemented to manufacture processes and they can work at one place for longer period (that eliminate cost for personal question –

searching, choosing, clothing, safety equipment, education – cost and time etc.). Employees are also exposed to risk of sick leave or occupation diseases.

Work complexity decreasing under trend influence of work safety improvement and quality improvement result into increasing of working unit efficiency that's mean the cost reduction. This state can be reached just through integration of never-ending improvement and complex re-engineering (expressed in cost – cost reduction and jumping investments to technology improvement).

5. Safety implementation to supply chain management

Implementation of never-ending improvement with continues quality checking and evaluating from the input to output through whole supply chain management is possible only by orientation at total quality management (on every level). Only this way can resulted into cost saving which can define a company to the position of leader on the market (in the case of prices dictate). The standard of total quality management has so many types of orientation the most important is ISO 9000 and their modification in relationship with customer. That means for supply chain manager needs to ensure not only the main flows but also reverse and return flows. Because reverse logistics is not only about

waste but also about conformity of customer services (complaining) and return logistics is about packages, transportation equipment etc. – the things which company uses in cycles.

After derivation at the single unit activities in logistics operations and implementation of integrated quality management policy we can solve question about sourcing. Which activities are cheaper for our company performed within own resources? Some group of activities can be made by one provider in the mode of party logistics (especially the third party logistics, most extend type of service outsourcing). However the main goal for SCM provider is not the cheapest solution but the most sustainable under condition of high efficiency. This conception must be better explained. Integrated logistics doesn't bring so many multiplications for economic benefits, but well organized whole supply chain from the start to the endpoint customer can bring much more synergy effects than only one provider can offer. That's mean only one budget for sustainable quality in every activity of supply chain (higher quality for lower prices) or much more value added activities than unnecessary downtimes, losses for many reasons, less number of bottlenecks, orientation for long term returns in green thinking logistics form etc. This type of thinking brings reassurance for customers. There works simply rule - when customer is satisfied than customer will come back and pay again. Many small successes take one big success. To maintain this success SCM provider needs simply tool – checking system. Checking system consist from audits, controlling, certificates and statistics. SCM provider finance all those audits etc. from own budget that mean the end customer pay it in end prices only once.

Supply chain model



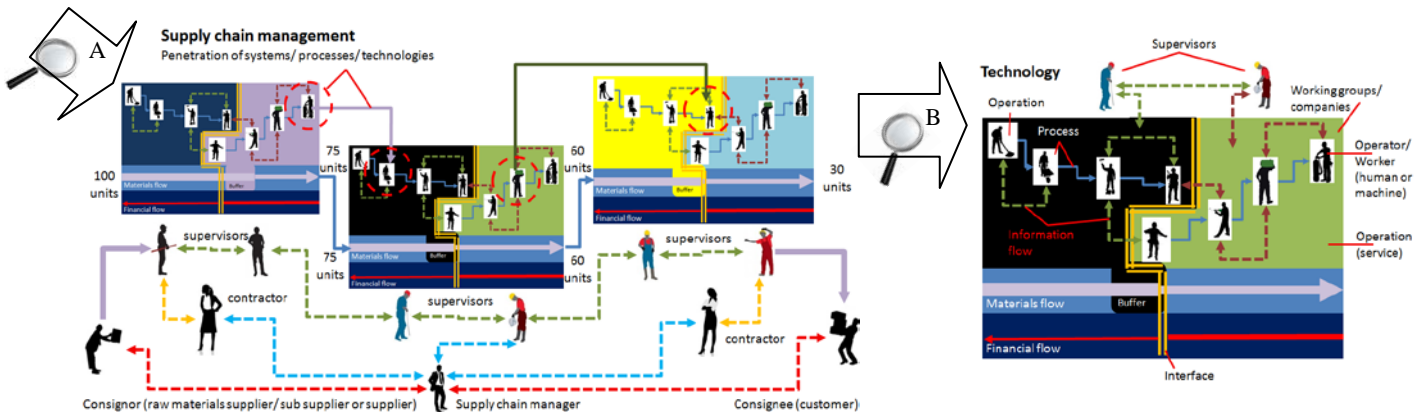


Fig. 4 The supply chain operations, process and activities derivations. The first figure is chosen example of common supply chain. The second one describes supply chain elements with material, information and management flows. And the last shows focused one of the elements

Source: authors

6. Conclusion

In conclusion, we can therefore summarize the known facts. Efficiency of transport can ensure just by transport company that has enough qualified and efficient staff. It understands the unique competitive advantage which employees are. Due to their quality system creates conditions for continuous never-ending process of improvement and copartner through the process of innovation are rightly proud and motivated to more responsible approach to work and more power. Moral motivation is they reach high efficiency, as evidenced by the safer handling and technology protection of the work. Cost savings for the unexpected downtime, eliminating systematic errors can dictate the price in the market. If you do this cycle counts and exceptional preparation for emergencies, allowing the company to react more quickly resulting in a reduction of unforced downtime costs, damages and removal of additional capital spending and time for giving facilities to their original condition. With quality management and crisis management firm is high flexibility almost invulnerable, but that all could work easily and effortlessly is still needed one last element the risk prevention. Prevention integrates risk management philosophy of the company both together. Quality management and risk prevention is an ongoing process. Incurred costs get back several forms mostly in the form of synergies. The fig. shows the risk matrix, which is a simple form how to indicate areas that need increased attention.

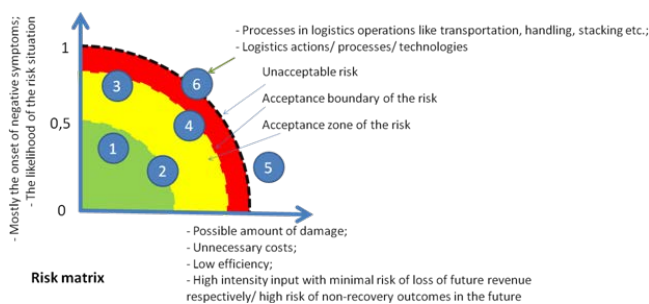


Fig. 5 The risk matrix – useful simply tool for identification of risks areas.

Source: authors

The last scheme shows conclusion. Companies dealing with logistics operations related with dangerous goods can use these conditions as their main goals for future improving and getting to the leader position on the market.

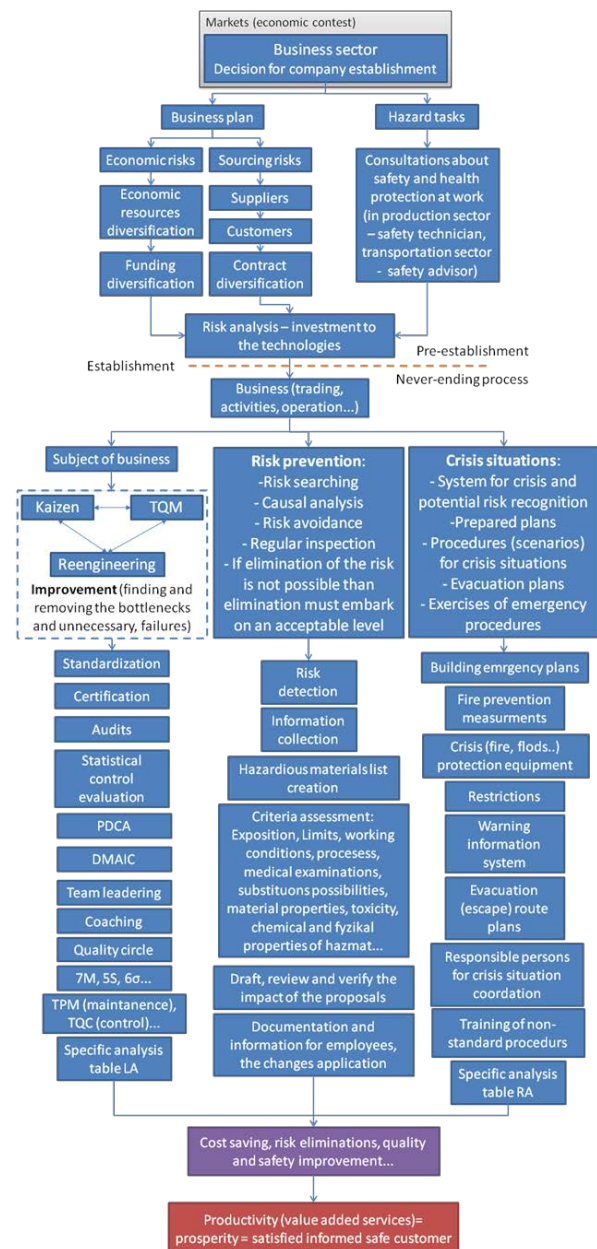


Fig. 6 The scheme for Safety and Health at Work in the performance of logistics activities carried out in the logistics point cut in production logistics intrusions. The scheme is applicable for the performance of activities such as carrier, manufacturer as well as other parties - organizations providing storage, packing, loading, unloading, etc.

Source: authors

7. Literature

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