**Appendix C. Supply Chain Vulnerabilities**

In the following we summarize the main findings reported in the literature on how AM affects each SC vulnerability. Out of the 7 SC capabilities defined by (Pettit *et al.*, 2010), Naghshineh and Carvalho (2022b) reports that AM affect only 6 of them: connectivity, deliberate threats, resource limits, sensitivity, supplier-costumer disruption, turbulence.

**Connectivity**

Related to this vulnerability, AM does not have only positive impacts. In fact, while from one side AM can mitigate SC vulnerability by favoring production reallocation and rerouting of requirements in case of both internal and external capacity shortage (Rogers, Baricz and Pawar, 2016), on the other side, the digitalized nature of AM has a high reliance on ICT infrastructure that, as demonstrated by Naghshineh and Carvalho (2022b), can be inadequate causing a threat to information flow. The other characteristic of AM negatively impacting connectivity is the scarcity of supplier of raw materials (cf. above) (Niaki and Nonino, 2017).

*V1i: AM mitigates the vulnerability “Connectivity” as there is an increase in the degree of outsourcing of production to external entities due to the digital nature of AM technology.*

*V1ii: AM increases the vulnerability “Connectivity” limiting information flows when adequate ICT infrastructures are missing.*

*V1iii: AM increases the vulnerability “Connectivity” as the limited number of suppliers of raw materials increases the reliance upon specialty sources.*

**Deliberate threats**

AM can create cybersecurity threats due to unreliable IT systems (Padmanabhan and Zhang, 2018). There are different types of attacks that can affects the AM-based SCs, such as printer hardware attack, design file attacks and file corruption (Gupta *et al.*, 2020), with the most relevant being the design file attacks. In fact, due to the high level of information exchange, AM increases the risk of exposing sensitive design information to industrial espionage (Kunovjanek, Knofius and Reiner, 2020). On the other hand, AM can also mitigate the exposure to threats intended as theft, sabotage, product liability since it distribute facilities among different locations (i.e., decentralized production).

*V2i: AM increases the vulnerability “Deliberate threats” as the high level of information exchange between partners in the supply chain exposes the supply chain to industrial espionage.*

*V2ii: AM mitigates the vulnerability “Deliberate threats” as the ability to disperse capacity to multiple production facilities increases resilience against threats; threats meaning theft, sabotage, product liability.*

**Resource limits**

AM has a negative effect on this SC vulnerability. Indeed, as discussed above, the limited number of suppliers of AM raw materials and with the required skills is well documented in literature (Niaki and Nonino, 2017). Therefore, despite the fact that more and more suppliers have been entering the market over the past years, the negative effect of AM on this SC vulnerability is nowadays still non-negligible (Wholers, 2023).

*V3: AM increases the vulnerability “Resource limits” as the reliance on very few suppliers in the supply chain causes exposure to raw material and supplier unavailability.*

**Sensitivity**

When it comes to AM, there is a lack of standardization for how to produce parts and on the raw material quality. Consequently, this has negative effects on this SC vulnerability. Indeed, raw materials with different quality lead to parts characterized by different amount of internal defects (and hence different properties) (Kim, Lin and Tseng, 2018); similarly, the use of different production parameters affects the quality of the final part (Kunovjanek and Reiner, 2020).

*V4:* *AM increases the vulnerability “Sensitivity” due to the lack of standardization.*

**Supplier-Costumer disruption**

The introduction of AM mitigates this vulnerability thanks to the different features described above that enable the reallocation of production and redistribution of capacity among different locations (Ford and Despeisse, 2016). In this way, AM can help in facing suppliers’ production capacity shortage due to internal/external disruptions (Strong *et al.*, 2018).

*V5:* *AM mitigates the vulnerability “Supplier-Costumer disruption” thanks to the possibility to reallocate production and distribute capacity to alternate production facilities.*

**Turbulence**

As it was for the previous SC vulnerability, AM mitigates turbulence thanks to the possibility to reallocate production and redistribute capacity among different locations. In this way, AM can help in facing SC disruptions due to changes in external factors beyond firm’s control (e.g. pandemic, natural disasters, geopolitical disruptions) (Ivanov, Dolgui and Sokolov, 2019).

*V6:* *AM mitigates the vulnerability “Turbulence” thanks to the possibility to reallocate production and distribute capacity to alternate production facilities.*

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