Describing vehicle movement patterns within a production system in the Midwest.

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Key Points

- Utilizing movement data to understand network connectivity can provide insights impacting disease control, animal welfare, and other areas.
- The number of vehicle movements is constant over season and year, with no high or low seasons indicating a constant level of contacts.
- From this subset of transport data, most of the trips are to sow farms (32.5%) and Truck-wash facilities (37.6%).
- The average time for vehicle cleaning, disinfection and baking (at the truck-wash facilities) was ~3hrs.

Animal movements are essential to the US swine industry. Transport of animals between sites within a system occur frequently as part of production management practices to increase animal health and production efficiency. Good biosecurity practices during animal transportation are essential to reduce the risk of pathogen persistence and transmission among animals moved between farms, and therefore need monitoring

In collaboration with an MSHMP participating system, tracking devices have been installed on 7 truck-trailers and 5 trailers, providing consistent vehicle movement data. While there are many goals for this long-term project, the first steps to gaining value are to understand typical route-circuits that can indicate the connectivity within the system. Ultimately, this information will help us to recognize potential behaviors that can help or hinder the spread of diseases, impact animal welfare, and allow a producer to better manage movements and biosecurity during a disease outbreak.

There were 4,103 trips recorded between January 2019 and June 2020 (3217 and 886 in 2019, and 2020 respectively) moving between 101 sites with different geolocated landmarks within the Midwest. These landmarks included farms (sow, GDU, nursery, wean-to-finish, finisher farms) and truck-wash facilities. The 7 trucks completed 79% of the trips and the rest (21%) were completed by the 5 trailers. The proportion of trips among seasons and between years was similar (~25% each season), with most of the trips made to sow farms (32.5%) and truck-wash facilities (37.6%) as represented in the graph.

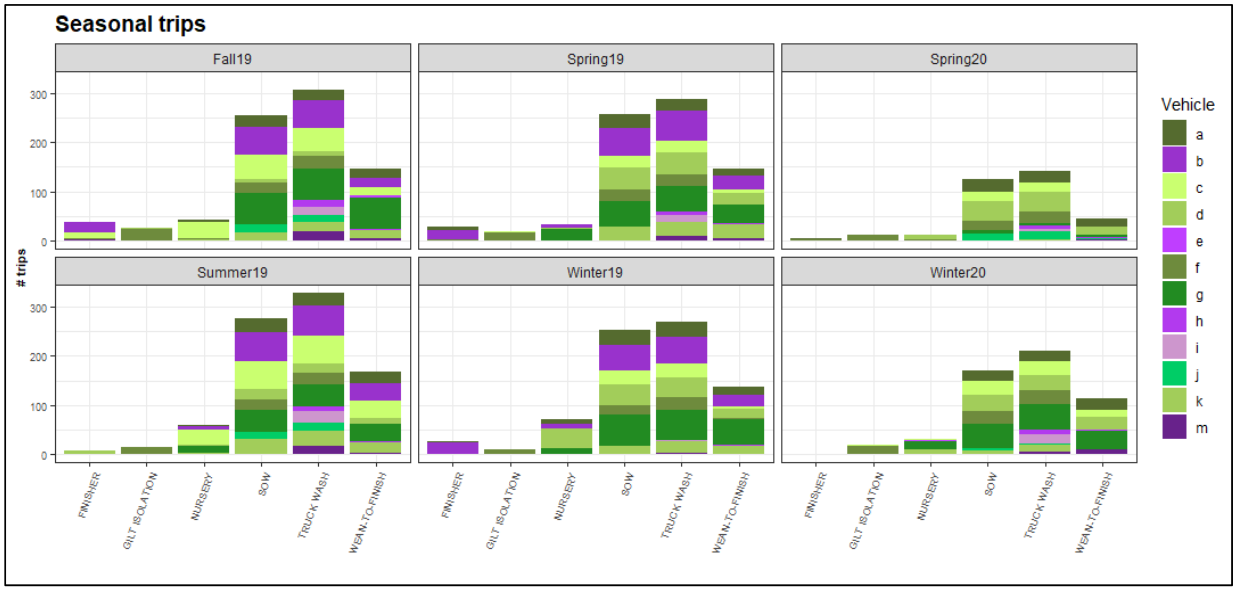

Figure 1: Breakdown of movement by season, vehicle, and site type destination

When vehicles entered a predetermined area, a signal was captured recording location and time spent there. After excluding vehicles that were parked at a landmark for more than 24 hours from the analysis, the overall time spent at the landmarks was on average 239 minutes (approx. 4 hrs). The time spent in each landmark by category is showed in the table below. Interestingly the time spent at the truck-wash was the longest observed, with the median time of washing-&-drying reaching 2.8 hours, enough time to properly clean and disinfect the vehicles.

Table 1: Time spent by vehicle at landmark by site type

	FINISHER (N=105)	GILT ISOLATION (N=101)	NURSERY (N=248)	SOW (N=1197)	TRUCK WASH (N=827)	WEAN-TO-FINISH (N=727)
Total.Mins						
Mean (SD)	67.8 (237)	115 (117)	50.7 (155)	175 (375)	579 (552)	68.5 (244)
Median [Min, Max]	22.0 [11.0, 1440]	82.0 [10.0, 602]	31.5 [10.0, 1440]	28.0 [10.0, 1290]	171 [17.0, 1440]	22.0 [10.0, 1440]

Capturing transport data in real-time and with a high degree of reliability is possible. Data analysis of vehicles movements can provide important information that helps in the understanding of system-wide connectivity. In addition, such data can be used to understand trucking efficiency and aid in the investigation of risky behaviors. This initial summary provides us with a clear sense of movement patterns in time, weight of farm type, and stop duration. The present analysis is the first step towards the understanding and capability development of movement data analysis.