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DIRECT AND HIDDEN COSTS IN IDENTITY PRESERVED SUPPLY CHAINS

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Any labeling scheme must be supported by an effective identity preservation system which implies extra logistical costs. Both direct and hidden costs exist in identity preserved systems. Such costs vary substantially with the configuration of individual supply chains and can be meaningful, especially under strict standards and thresholds.

Key words: identity preservation (IP); supply chain; grain; elevator.

Any labeling scheme—voluntary or mandatory—must be supported by effective identity preservation of foods and food ingredients from seed to the final consumer. Identity preserved (IP) supply chains forego efficiencies present in commodity chains and imply extra logistical costs.

Some recent studies shed light on the size of certain direct IP costs in grain supply chains (Lin *et al*., 2000; Bender *et al*., 1999; Hurburgh, 1994). Other IP costs, however, remain unarticulated. For instance, local or regional elevators derive revenues from value added activities (e.g., grinding) or from carrying spreads, which are relinquished in IP supply chains. Such foregone revenues are real, though somewhat hidden, costs associated with IP. Similar hidden costs exist all along IP chains.

Accurate assessment of direct and hidden IP costs is complicated by inherent difficulties in generalizing across grain supply chains. Differences in local supply conditions and asset configurations at the farm, elevator, and processor level can produce substantial variation in IP costs. In this article, we provide estimates for both direct and hidden IP costs at the elevator level and demonstrate the significance of local supply conditions and asset configuration on their relative size. We focus our attention on elevators as they represent the most significant bottleneck in IP grain supply chains.

Estimating An Elevator's IP Costs

In traditional commodity supply chains, the elevator's role is crucial in sourcing sparse farm production for a concentrated processing and milling industry. Over the years, asset configuration and logistics of commodity grain handling have been optimized and elevator managers have built operating margins from scale. However, elevators in IP supply chains accept changing roles. In

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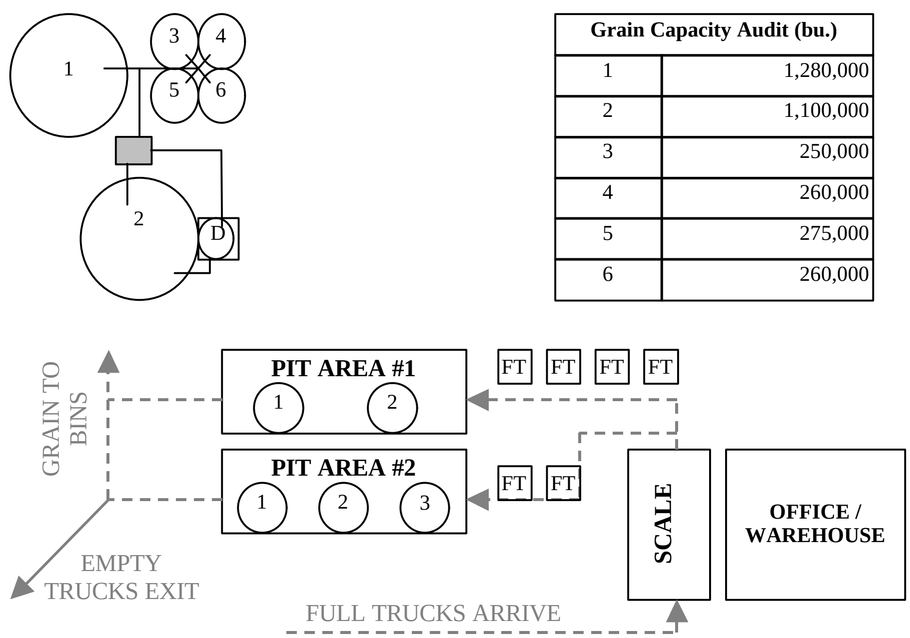
addition to efficiently equating product supply with demand over time and space, local and regional elevators must generate, store, and transfer product and source information. Logistical redesign is necessary and can lead to additional expense. Ultimately the value of the IP information must net expenses plus a competitive margin. Consequently, the costs of IP are central in determining return-on-investment for any elevator considering participation in an IP supply chain.

To estimate IP costs, we built the Process & Economic Simulation of IP (PRESIP). The PRESIP model is designed to capture the subtle intricacies of day-to-day operations, chain coordination, and relevant costs in IP supply chains for grains. Its structure is flexible and can be adjusted to simulate any asset configuration that may be encountered.
In the case of an elevator, two integrated modules in PRESIP capture the “essence of riding a bushel of grain from the farm through the elevator.” The Elevator Asset Configuration Module mimics the physical configuration of elevator assets including dumping pits, scales, queues, storage bins, and other assets (figure 1).



Grain Capacity Audit (bu.)	
1	1,280,000
2	1,100,000
3	250,000
4	260,000
5	275,000
6	260,000

Figure 1: Example of Elevator Layout in PRESIP.

The Elevator Grain Flow Module captures the flow of incoming trucks, movement of trucks through the elevator, and within-elevator grain. The combination of these modules tracks all grain (commodity and IP) from elevator arrival to usage—either outbound shipment or in-house grinding.

Physical data on the movement of grain are fed into the Elevator Economic Analysis Module, which estimates three categories of IP costs: coordination, logistical, and opportunity costs. Coordination costs are incurred as elevator managers find farmers to produce the grain, verify that these farms have the proper production practices, and contract for production. For buyer-call contracts, there are additional coordination costs for elevator management meetings and producer calls throughout the year.

Logistical costs specific to IP may include multi-year depreciable investments such as compositional analysis and other testing equipment as well as necessary asset upgrades and modifications. They may also involve single season expenditures such as incremental labor for IP handling, additional material and maintenance costs, management of increased farmer dispute, and the costs of misgrades (e.g., where IP stock is accidentally stored as commodity).

Hidden or opportunity costs in IP may also exist. Grind margin loss may be incurred by substituting local production of commodity crops often ground for resale as feed. For every bushel of commodity grain lost to IP, there is the lost potential margin. Storage margin opportunity costs are foregone revenues from under-utilized storage capacity - a primary concern to 85% of the elevator managers surveyed by E-Markets in its Grain Industry 2000 report. The PRESIP model generates a commodity-only baseline and then compares subsequent IP scenarios to the daily capacity utilization of the baseline. Negative shifts in capacity utilization are multiplied by an average storage margin to assign the lost revenue as a result of IP handling.

The final opportunity cost is a result of scheduled deliveries from the elevator to another intermediary or the end-user. Each scheduled delivery forces the elevator manager to release stock at specific times thereby relinquishing the option to hold grain for carrying spreads. Opportunity costs exist for deliveries in which there is “spread” in the market—a positive net difference between current price and expected future price less cumulative storage and lost interest costs. Using historical spread information (indexed on a constant dollar basis), the PRESIP model assigns an estimated gross spread on each delivery date. Deliveries made on dates with positive spreads are assigned the lost revenue the manager would realize from carrying.

Three Case Studies

To provide a perspective on the size of IP costs, both direct and hidden, estimates from PRESIP are presented here for three case elevators. The case elevators, located in Missouri and Illinois, were selected to represent different sizes and functions that are common in the Midwest. In this way, the variation of IP costs across different asset configuration is illustrated. For each PRESIP simulation, actual operating data were obtained through personal interviews with the elevator managers. In all three cases the costs of identity preserving high oil corn (HOC) at 5% purity level are calculated.

The first elevator [Elevator #1] is a smaller-size Missouri farm supply/grain-merchandising facility. Its operating capacity is 306,800 bushels with annual throughput of 1.25 million bushels. Elevator #1 has two bins of approximately 100,000 bushels used for terminal storage with 14 other smaller bins (2,400-18,000 bushels) used both for terminal storage and temporary turning of stocks. This elevator has only one pit area in which there are two dumping pits - Pit #1 is assigned to soybeans and Pit #2 is shared by corn and sorghum, often causing significant changeover delays at harvest. Soybean margin is derived from merchandising; grinding margin is derived from corn and sorghum. Elevator #1 is restricted by geography to outbound delivery by truck only.

Elevator #2 is a larger cooperative, merchandising elevator in Illinois and handles IP crops without using dedicated facilities. Elevator #2 operates at a capacity of 1,513,900 bushels with an annual throughput of 3 million bushels and does not have grinding facilities. This elevator has three dumping pits in two pit areas - primarily one crop type per pit without changeover. There are twelve small bins (5000-30,000-bushels) for turning and drying operations. A “honeycomb” of thirteen storage bins of 28,000-bushels per bin is used for terminal storage as well as two 125,000-bushel flats and one 480,000-bushel bin. Elevator #2 can deliver outbound loads of grain by truck or rail.

Elevator #3 is a large, river terminal elevator located on the Missouri River. Its capacity is 2,665,000 bushels with an annual throughput of 4.5 million bushels. There are two pit areas (two pits per area). Most bins at this facility are very large with one holding flat of 1.8 million bushels and one large bin of 400,000 bushels. There are four terminal bins of approximately 100,000 bushels and then a few turning bins below this capacity. Finally, Elevator #3 can deliver grain directly from the bin by truck or rail. For barge delivery, the elevator must dump the grain into a truck and move the grain over a levy into the barge (i.e., the barge cannot be loaded directly from storage bins).

Multiple scenarios of bin filling schedules, crop-to-bin assignments, incoming volumes, and other key parameters were simulated using PRESIP to derive efficient IP handling. Accordingly, the costs presented here are the lowest per bushel costs for which all constraints of contractual delivery, practical bin filling patterns, management designated checks, and volume patterns are met. Five distinct scenarios for each of the case study elevators are presented here:

- 100,000 bushels of incoming HOC delivered during peak harvest [100K HD]
- 100,000 bushels of incoming HOC delivered through buyer call [100K BCD]
- 200,000 bushels of incoming HOC delivered during peak harvest [200K HD]
- 200,000 bushels of incoming HOC delivered through buyer call [200K BCD]
- and 500,000 bushels of incoming HOC delivered during peak harvest [500K].

In each of these scenarios, the first scheduled delivery of HOC to the end-user occurs on December 1. The assumption is that the end-user has 10,000 bushels of temporary storage to accept HOC delivery and receives such an amount every seven days.

Empirical Results

To reduce the volume of empirical results, details are presented in table 1 for Elevator #2 while more aggregate results are presented for Elevators #1 and #3. Coordination costs are rather stable at less than $0.03/bushel and increase only slightly with buyer call contracting. Segregation costs are somewhat higher with testing being a large portion of these costs. At the 100K volume, the elevator finds that, rather than purchase analysis equipment, it is cheaper to ship samples via a national carrier (e.g., Federal Express®) to a third-party certification site. At the 200K and 500K volumes, the elevator finds more efficiency in purchasing the analysis unit.

Hidden or opportunity costs are the most prohibitive costs to IP. In particular, Elevator #2's spread opportunity costs, ranging from $0.07-0.19 per bushel, are significant. In addition, the highest of these costs occurs at the 200K volumes. The variation illustrates the significance of local supply conditions. For the case elevator, spread opportunity costs at the 100K-volume reflect substitution of HOC from 100,000 bushels of local, commodity corn supply. For the 200K volume scenarios, substitution of HOC from the next 100,000 bushels is taken primarily from local soybean supply resulting in higher opportunity costs. Similar substitution effects exist at the 500K volume, but larger volume allows better allocation of costs. At $0.16-0.27 per bushel, the sum of coordination, segregation and opportunity costs is clearly not trivial and therefore important in the management's decision to participate in IP supply chains.

Table 1: IP Cost Structure for Elevator #2 ($ / bushel).

Category	100K HD	100K BCD	200K HD	200K BCD	500K HD
Coordination Costs					
Farmer Search Costs	0.028	0.029	0.028	0.029	0.028
Advertising	0.025	0.025	0.025	0.025	0.025
Follow-up calls	0.002	0.002	0.002	0.002	0.002
Farm visits	0.001	0.002	0.001	0.002	0.001
Buyer Call Delivery	0.000	0.007	0.000	0.008	0.000
Weekly meeting	0.000	0.006	0.000	0.007	0.000
Farmer calls	0.000	0.001	0.000	0.001	0.000
Coordination Costs	**0.028**	**0.036**	**0.028**	**0.037**	**0.028**
Segregation Costs					
Sample analysis cost	0.031	0.031	0.026	0.025	0.011
Misgrades	0.000	0.000	0.000	0.000	0.003
Maintenance	0.001	0.001	0.006	0.006	0.003
Disputes/labor	0.001	0.001	0.001	0.001	0.000
Other	0.016	0.017	0.009	0.009	0.004
Segregation Costs	**0.049**	**0.050**	**0.042**	**0.041**	**0.021**
Opportunity Costs					
Under-utilized storage	0.029	0.016	0.017	0.011	0.030
Lost grind margin	0.000	0.000	0.000	0.000	0.000
Spread opportunity	0.070	0.069	0.187	0.166	0.085
Opportunity Costs	**0.099**	**0.085**	**0.204**	**0.177**	**0.115**
Total IP Costs	**0.176**	**0.171**	**0.274**	**0.255**	**0.164**
Standard Deviation	0.060	0.054	0.085	0.054	0.030
90% Confidence Upper	0.189	0.183	0.293	0.267	0.170
90% Confidence Lower	0.161	0.157	0.253	0.242	0.156

Note. Unless noted, all costs shown as mean result.

Comparative Costs

In all scenarios, Elevator #2 has a significant advantage driven by significantly lower opportunity costs (table 2). It also has the lowest mean per bushel cost of $0.164 at the 500K volume.

The “honeycomb” configuration of thirty storage bins of approximately 28,000-bushels offers Elevator #2 greater flexibility in filling patterns to maximize storage utilization within the batch-processing IP system. Elevator #1's primary disadvantage is significantly decreased carry revenue, up to $0.21/bushel, as its local producers substitute out soybean production. Elevator #1's most interesting scenario is at 500K in which the entire facility is dedicated to HOC, yet this “dedicated facility” scenario does not produce the lowest per bushel cost. Potential operational efficiencies from a dedicated facility are offset by grinding and spread opportunity costs.

Elevator #3 faces two primary problems with IP. The first is significant carry opportunity costs ranging from $0.07-0.22/bushel with a similar to Elevator #2 local production-driven cost spike in the 200K scenarios. However, under-utilized capacity is the largest issue for Elevator #3. With low incoming HOC volumes in relation to its historical commodity stocks, Elevator #3 finds that it cannot fill its large bins (100,000-1,800,000-bushels) as quickly as it can with commodity stocks. Consequently, its storage margin opportunity costs range from $0.06-0.15 per bushel.

Table 2: Comparative Cost Structures ($ / bushel).

Category	100K HD	100K BCD	200K HD	200K BCD	500K HD
Elevator #1 -	0.335	0.275	0.337	0.290[3]	0.354
90% CI	(0.317-0.353)	(0.256-0.294)	(0.321-0.352)	(0.275-0.305)	(0.339-0.368)
Elevator #2 -	0.176[1,3]	0.171[1,3]	0.274[1,3]	0.255[1,3]	0.164[1,3]
90% CI	(0.161-0.189)	(0.157-0.183)	(0.293-0.253)	(0.242-0.267)	(0.156-0.170)
Elevator #3 -	0.236[1]	0.231[1]	0.366	0.362	0.305[1]
90% CI	(0.218-0.254)	(0.214-0.248)	(0.346-0.387)	(0.341-0.382)	(0.281-0.329)

Note. [1] Statistically significant cost advantage over Elevator #1. [3] Statistically significant cost advantage over Elevator #3.

Concluding Comments And Implications

The three case studies of identity preservation presented here at the elevator level suggest the importance of hidden or opportunity costs that can occur from adapting current commodity operations to IP. Potential revenue streams may change drastically as bin filling patterns shift, grind margins are lost, and carry returns are foregone under specific contractual agreements. Especially important are the effects of local supply conditions and asset configuration on IP costs. Such variation in both direct and hidden IP costs exists throughout the supply chain. Hence, care must be taken in any attempt to generalize IP costs across different supply chains.

It is also important to clearly define the scope of the results presented here. In the listed case studies, PRESIP simulations were developed under a generous 5% allowable threshold of contamination from other varieties/hybrids. As such, these costs do not strictly apply to supply chains with narrower thresholds – as those required for genetically modified foods in the European Union. Within the bounds of less than 1% percent thresholds, new operational challenges and testing requirements are created. Additional operational changes such as sealed bins, additional cleaning of pollen and grain residue, dedicated delivery dates, insurance or non-compliance penalties add extra costs to IP not accounted for in this study. In addition, testing the presence of GM material at the protein and DNA levels is more expensive than for value-added compositional analysis used here. Some preliminary modeling of such stricter IP supply chains suggests that IP costs tend to increase in a non-linear fashion for very low threshold levels (e.g., near zero) and, in some instances, can make identity preservation prohibitively expensive.

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