



Short Communication

Packaged Food Industry: Wake Up, Your Complex, Costly Equipment Hides Pathogens and Extends Lead Times

Richard J. Schonberger*

Independent Researcher, USA

***Corresponding author:** Richard J. Schonberger, Independent researcher, author, speaker, 177 107th Ave. NE, #2101, Bellevue, WA 98004, USA. Tel: +14254671143; Email: sainc17@centurylink.net

Citation: Schonberger RA (2018) Packaged Food Industry: Wake Up, Your Complex, Costly Equipment Hides Pathogens and Extends Lead Times. Adv Food Process Technol: AFPT-109. DOI: 10.29011/AFPT-109.100009

Received Date: 25 June, 2018; **Accepted date:** 12 July, 2018; **Published Date:** 18 July, 2018

Introduction

This article concerns the packaged-foods industry's complex, pathogen-loving manufacturing equipment-and the massive costs of keeping those pathogens from ending up in its packaged foods and avert product recalls. It advocates major changes in the way the industry equips and operates its factories-away from high-cost, complex, high-maintenance, multi-product production lines and forward to multiple simpler, easier-to-clean and change-over product-focused lines that reduce outsized inventories in distribution systems and get the right mixes of goods to customer entities with much shorter lead times.

Packaged, bottled, and canned foods-from soup to nuts-are produced, typically, on costly, complex, high-speed, high-output, high-downtime equipment. Production is in large batches of only one product type at a time, well out of tune with demand patterns in the market place. I've explained-in other articles and in conference presentations-why such equipment is detrimental to the competitiveness of the very companies that operate with it. Specifically, in packaged foods, such equipment is difficult to clean and difficult to change from one food SKU (stock-keeping unit) to another, thus raising risks of contamination. By necessity the packaged-foods industry devotes inordinate time and attention to clean-outs and changeovers. A special-to-the-foods-industry reason is that food-processing equipment has maximum exposure to pathogens during cleaning and changeover. Good Manufacturing Practices (GMPs) include strict protocols on how cleaning and product changes must be done.

Re-equipping for Safety and Competitiveness

Good business practices, however, are to minimize pathogen exposure by changing the physical and operating nature of the

equipment itself in ways that minimize the frequency and difficulties of cleaning and changing. Many manufacturers in other industries (e.g., electrical products, metal-working, even passenger aircraft) have undergone such equipment transformations-though sometimes hesitantly, given the "sunk cost" of their existing typically outsized, high-speed legacy equipment-referred to in lean-manufacturing parlance as monuments. They choose to embark on down-scaling their equipment even though, unlike packaged foods, there is little or no pathogen-driven reason for doing so. Here are the general characteristics of equipment in wide use in packaged foods in comparison with the down-sized alternative:

Typical equipment in packaged foods consists of one or two or three, long, multi-channel conveyORIZED fill-and-pack lines, fed by a series of upstream bulk (or in some cases, in-line) processors-mixers, blenders, dissolvers, filters, cookers, dosers, and so forth. The alternative-entailing fewer and simpler cleans and changeovers-is multiple smaller, simpler, low-cost versions of all or most of the equipment, both for formulating the mix and for filling and packing for shipment, thus to produce many products simultaneously: smaller mixers, blenders, extruders, fillers, formers, cookers, ovens, coolers, packers, and so on.

Nicholas [1] explained the difference: "The alternate to costly multipurpose or special-order machines is inexpensive, slower, and fewer-purpose machines, but many of them. Every work cell that needs one gets one and can then function autonomously." In elaboration under "Abolish the Setup" Nicholas [2] explains that each cell turns out a different family of products in the mode of "simultaneous production.... When machines are devoted to one part (or similar kinds of parts), changeover between parts is eliminated or is reduced to trivial steps." See, also, Hall's [3] discussion of "The Virtues of Inexpensive Equipment."

Dairies Are Different.

One food industry segment sits on the ragged edge of doing foods right: dairies. With its need to “keep it cold, keep it fresh, keep it moving” (an actual marketing slogan of a Seattle dairy years ago) dairies, by necessity, have seen fit to equip with multiple fill-and-pack lines, each dedicated to its own product family. Cell-like, the lines are compact, usually single channel, with relatively short lengths of conveyor between operations.

If, instead, a dairy with, say, 60 liquid SKUs were to equip itself to run them all through just two or three long, complex, multi-product fill-and-pack lines, the penalties would be severe: prohibitively time-consuming and microbe-breeding-cleanouts and changeovers eating up competitively essential sell-by times and raising the risk of a costly product recall.

Downsizing Equipment, Upping Product Safety and Customer Responsiveness

Most of the foods sector is in need of an overhaul of their equipment to enable concurrent (simultaneous) production in multiple stubby production lines or compact work cells. Included product types are liquids, powders, grains, and nuggets that pour forth, are extruded, or molded in early phases, and onward through forming, filling, finishing and pack-out. Some fresh foods, too, may benefit from multiples of smaller-scale equipment in the concurrent-production mode; see, for example Schonberger [4] which describes this for a plant that processes fresh pork products. See, also, the sidebar on the dairy industry.

Pathogen risks worsen as processing lines lengthen and widen; as the number of SKUs grows; and as the number of steps in the upstream batch processes increases. At the same time, lead times lengthen, creating product mixes out of tune with end-product customer demand patterns and compromising product freshness and sell-by dates. Telling evidence of the dominance of this are outsized inventories in producers’ distribution centers, and downstream among distributors and at retail beyond: Long-range global inventory research shows, among 32 sectors, food/beverage/tobacco ranking a dismal 25th, retail not much better at 22nd and distribution at 20th [5].

It is an oddity that, among the dozens of books and many hundreds of articles that have been published on just-in-time production and lean manufacturing, scarcely any are specific to pack-

aged foods and to the pathogens issue. Among the few exceptions are: an article on packaged goods in general that includes a section on beverages; a case study on frozen foods; a recent article that features segregated production lines for producing nutrition bars; and a pasta sauce/salsa plant that is electing to use more and smaller-scale equipment. Each example is summarized next, the first two emphasizing poor designs of production lines mainly from an economic standpoint; and the next two showing correctively good designs considering product-safety as well as economic considerations.

Brewing Industry Example

The beverages example [6] offers specifics on equipment-related deficiencies found in the breweries of one of the world’s largest beer-producers, paraphrased here:

- Too many SKUs competing for production time-and subsequent issues in the marketplace-among few, excessively-long bottling and canning lines.
- Many long segments of non-value-adding conveyors, holding thousands of in-process bottles and cans-8, 10, or 12 abreast-the dubious purpose of which is to isolate a stoppage while the rest of the line is kept going with plentiful inventory.
- Spills and breakage, nearly always in sight, evidence of frequent mishaps; operators intermittently rushing to the next hot spots for trouble-shooting, permanent fixes put off because they require production shut-downs and capital investment.
- High overhead costs for engineers to design, acquire, and maintain the costly, complex, frequently jammed-up, high-speed equipment.
- Pressure to run the lines ever faster and with maximum shifts per week, to justify high capital and overhead costs, compensate for frequent stoppages, and offset stops for changeovers necessary to accommodate all the SKUs.
- High line speeds and high utilization, which contribute to the stoppages and failures.

Serious consequences of all this go beyond the plants in the form of outsized finished goods and long lead times in distribution channels. That the few bottling and canning lines can make only a few SKUs at a time results in production being out of synch with downstream demand and usage, resulting in retail shelves empty of hot items and stockrooms bulging with items in declining demand. Manufacturing is not inclined to consider those negatives, measuring itself on the false gods of maximum output and high capacity utilization. It is left to marketers and distribution managers to deal with customer companies-who bear the burdens of the gluts and back-orders. Stock outs, which have been a chronic problem for at least 50 years [7,8], have seen little improvement, notwithstanding this age of high emphasis on supply-chain management.

Case Study in Frozen Foods

A more detailed example of fill-and-pack-line miseries comes from a case study, Swanbank Frozen Foods [9], which produced frozen “TV dinners” on three 600-to-850-foot-long fill-and-pack lines. (The name of the case study, disguised at the time, no longer need be since it has been shuttered for many years: It was a Campbell Soup/Swanson plant in Salisbury, MD, in the mid-1980s). Following are excerpts from the case study:

Tray-filling lines were designed to run at 270 trays per minute ... but at that speed, past many fill stations through not-always straight and level conveyors into temperamental cartoning/packaging equipment, slight misalignments could lead to spectacular jam-ups, trays and contents flying into the air, littering the floor and equipment with gravy, peas, and apple cobbler. Mean stoppage time was three hours with an average of 26 stoppages per shift. To cope, the lines had been designed with plentiful extra conveyor, typically enough between stations to carry a few dozen trays, so that upon a stoppage the crew of 50 or 60 operators could hand-carry some trays around the stoppage to keep the rest of the line going. During longer stoppages (e.g., 20+ minutes) operators would run out of trays and be idled until maintenance could fix the problem. A five-person maintenance crew took over third shift-half disengaging filling equipment from the conveyor and re-engaging for the next shift, while the others took on the task of scraping, brooming, and shoveling the litter of food and containers, some going into garbage cans, the rest pushed into a trough centered under the conveyor. Their remaining task was to completely flush and steam-clean the equipment that had been removed from the line. Needless to say, that trays are open to environmental contaminants at many stop-and-start stages raises product safety risks.

Note: This example is not an outlier but was and is typical of food plants having as high a degree of product-to-product complexity as was this plant, with its light-weight aluminum trays, many different food items, and wide mix of feeder types. Campbell Soup had hired one of the case-study authors to conduct training in designing simpler, more effective production lines, with plant tours woven in so that the training could be customized to the plants. (This was not in connection with consulting; rather it was to provide Campbell’s people with methodologies and concepts for re-design of production systems themselves.) In this, corporate executives at Campbell were endeavoring to gain competitive advantages over other companies in its industry, and to catch up with companies advanced in JIT production in other sectors. As one indicator of success in this, Campbell’s inventory turnover had improved from 4.3 turns in 1984 to 6.3 in 1995 (though it didn’t last: its inventory performance has waned and waxed since then.)

Before the day of training at the Salisbury plant was finished, the plant manager announced that the first step would be to replace the automated cartoning and packing equipment with simpler, more reliable semi-automatic versions. Next in a stepwise transition was to greatly reduce the length and complexity of the

fill-and-pack lines, while adding more production lines or cells so that each could be focused on its own family of SKUs—such focusing to greatly reduce hassles and risks entailed in product changeovers. The new lines were to be equipped with slower and simpler extruders, fillers, etc., and over time to similarly modify the three original lines, thus to reduce spills and mop-ups, and eliminate many potential sources of product contamination.

In transitions such as this, one or more existing high-speed lines might be repurposed-dedicated to a single, narrow family of “Runners,” rather than being in perpetual states of changeover. The term runner refers to a given plant’s highest sales-volume product (SKU) family. Other SKUs may fall into the categories, “Repeaters” (moderate-volume, moderate-variety products) to be produced in semi-dedicated lines or cells; and “Strangers” (lowest-volume, highest-mix products) made in quick-changeover cells. This lean/JIT concept of runners, repeaters, and strangers (originated by Parnaby, [10]) offers a useful model for segregating products according to different degrees of speed, dedication, complexity, and so on. This way of distinguishing among product models by runners, repeaters, and strangers has been adopted, to good advantage, by leaders among the lean/JIT community in many sectors, though seldom in packaged foods.

High-nutrition health bars. Multi-layered candy bars are nearly always produced on multi-function fill-and-pack lines—which are in a perpetual state of changeover and clean-out from one bar to another. One manufacturer, Nellson LLC, recently opened a plant for producing branded and private-label nutrition bars in a wide variety of shapes, sizes, and outside coatings. The objective was “to segregate our production lines for maximum food safety [and], allergen segregation” [11]. The new plant, in Ontario, California, has a long and narrow shape, which the company exploited by dividing the length into separate production lines. One important factor is heightened concern among the company’s “brand partners” over allergen control. As to that the company created a production environment to eliminate “cross-contamination”, which meant setting up production lines so that each is “...essentially a plant within a plant.” Such segregation minimizes product changeovers and simplifies clean-outs. To further extend the benefits, Nellson is equipping its other plants (e.g., an existing one on the East Coast) following the Copy Exactly! concepts originating at Intel in the 1990s and described at Intel [12].

Cooking and blending pasta sauces and salsas. Chelton House’s newer West Coast plant [13] is configured differently from its older home plant in Bridgeport, New Jersey. Somewhat similar to Nellson’s segregated nutrition-bar lines, Chelton’s Las Vegas plant is set up with four independent kitchens and packaging lines, and “Paste and diced lines were dedicated from the storage tanks to the kettles to prevent cross-contamination.” Further, in keeping with the advanced equipment concepts in other industries, Chelton prefers smaller cooking kettles so that they can cook multiple product varieties at the same time (the concurrent-production

concept), which reduces frequency of cleaning and changing from product to product-and thus lowering pathogen risks.

Re-equipping Packaged Foods: New Opportunities for Equipment Producers and Challenges for Foods Manufacturers

As packaged food and beverage companies come to understand and apply the principles of multiple, simple, low-cost production lines, it opens up new opportunities and challenges for the companies that produce and install equipment. That industry has been in the race for bigger, wider, faster for so long that its catalog offerings of small-scale versions of its equipment have become meagre. The equipment makers compete on the basis of maximum output per day, and mindsets of design engineers and production engineers are attuned to the same: Engineers at both the machine manufacturers and the using foods producers revel in the challenges of packing more capability and higher speeds into a single unitary machine or a multi-product production line. For their part, production managers welcome the challenges of getting the most out of the complex equipment, and their colleagues in maintenance see their paychecks as revolving around reducing downtimes, both for changeovers and for breakdowns. The thinking is that achieving these (questionable) objectives can add impressively to the resumes of those engineers and production people.

What is needed to bring about enlightened mindsets on equipping for concurrent production is more success stories within packaged-foods plants. These may consist of incremental changes, not necessarily replacing or moving whole, long, multi-function lines with two or more short, dedicated ones. It may begin with just replacing, here and there, a problematic piece of equipment-a complex unit that is difficult to maintain or changeover or keep clean and pathogen free-with two or more units dedicated to certain of the SKUs arriving from the upstream process. Examples: replacing a too-large in-process dryer or mixer with smaller ones, each dedicated to different temperature, timing, or fineness specs; or, as at the Campbell-Swanson plant, replacing a cantankerous high-speed, automated packing machine with one or more low-cost, semi-automated versions. Further, plants should be continually pilot-testing new proposals, such as a stubby dedicated line segment designed to replace a section of the typical very long one. Such pilot tests can sometimes be done without going through feasibility studies, return-on-investment analysis, and budgetary processes: These kinds of pilot tests involve small investments that do not warrant the kinds of elaborate approvals that govern capital-investment-grade proposals.

When plant people have a success in these kinds of pilot tests, it behooves them to make a big deal of it-because it can be

instrumental in breaking through mindsets that have long favored monument kinds of equipment and production lines (yes, most production lines in packaged foods and beverages must be seen as fitting lean's definition of monument). These successes may be heralded with before-and-after photos, signage showing results (less maintenance, fewer and simpler changeovers, fewer and quicker clean-outs, shorter flow times, and fewer regulatory issues), presentations to higher management by operators, new paint jobs for that area, and so on. Further, it makes sense to have the success stories written up in trade magazines such as *Advances in Food Processing and Technology*, *Assembly Magazine*, and *Manufacturing Engineering*. Tell the world of packaged foods, so that the march toward rational, customer-focused food-processing can acquire and maintain a head of steam.

References

1. Nicholas J (2011) *Lean Production for Competitive Advantage*. Boca Raton, Fla.: CRC Press.
2. Nicholas J (1998) *Manufacturing Management: Continuous Improvement, Lean Production, and Customer-Focused Quality*. Boston, Mass.: Irwin McGraw-Hill.
3. Hall RW (1987) *Attaining Manufacturing Excellence: Just in Time, Total Quality, Total People Involvement*. Homewood Ill, Dow Jones-Irwin.
4. Schonberger RJ (2015) Better together: Combining process flow with quality. *Quality Progress* 48: 38-43.
5. Schonberger RJ (2016) Cycles of lean: Findings from the leanness Studies, Part 2. *Management Accounting Quarterly* 16: 18-27.
6. Schonberger RJ (2011) Can lean manufacturing find its way in packaged goods? *Target*:19-24.
7. Neilsen AC (1968a) The out-of-stock study: a crusade against stock-outs. *Progressive Grocer* 47: 55-71.
8. Neilsen AC (1968b) The out-of-stock study: a crusade against stock-outs. *Progressive Grocer* 47: 49-64.
9. Schonberger RJ, Knod EM (1997) *Operations Management: Customer-Focused Principles*. 6th edition. Homewood Ill, R.D. Irwin.
10. Parnaby J (1988) A systems approach to the implementation of JIT methodologies at Lucas Industries. *International Journal of Production Research* 26: 483-492.
11. Osborne J (2018) Setting the bar: Nellson LLC opens a new nutrition bar manufacturing facility in Ontario, California. *Food Manufacturing* 31: 18-23.
12. Intel (2000) Working hard with Intel.
13. Labs W (2014) Fabulous food plant: Chelton House heads west to meet market demand. *Food Engineering*.