Woollard's Eighteen Principles of Flow Production

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Frank G. Woollard, the long-forgotten 1920s British pioneer of flow production, made many unique contributions including the establishment of 18 principles of flow production. Woollard recognized that flow necessarily drives everyone to the same principles and eventually to the same practices as well. Knowing this can help us avoid the perennial problem in Lean management of periodically re-discovering that which was previously done so well but has been forgotten.

In his book *Principles of Mass and Flow Production* [1], published in 1954, Frank G. Woollard said: "When setting up a flow production plant there are certain basic principles that must be obeyed. They are all simple and virtually axiomatic…" Mr. Woollard identified 18 principles, listed below, all of which relate directly to our current day understanding of Lean production.

Woollard's Principles of Flow Production

1. a) Mass production demands mass consumption. b) Flow production requires continuity of demand.	10. Operations must be based on motion study and time study.
2. The products of the system must be specialized.	11. Accuracy of work must be strictly maintained.
3. The products of the system must be standardized.	12. Long-term planning, based on precise knowledge, is essential.
4. The products of the system must be simplified in general and in detail.	13. Maintenance must be by anticipation – never by default.
5. All material supplies must conform to specification.	14. Every mechanical aid must be adopted for man and machine.
6. All supplies must be delivered to strict timetable.	15. Every activity must be studied for the economic application of power.
7. The machines must be continually fed with sound material.	16. Information on costs must be promptly available.
8. Processing must be progressive and continuous.	17. Machines should be designed to suit the tasks they perform.
9. A time cycle must be set and maintained.	18. The system of production must benefit everyone – consumers, workers, and owners.

His book, republished in January 2009 as a 55th Anniversary Special Reprint Edition [2], explains each one of the 18 principles in detail. It is well worth reading to understand the 18 principles and also to recognize Woollard's many important contributions to flow production, industrial management, and automation, between the time of Henry Ford in the United States and Kiichiro Toyoda in Japan.

Later in 1954, Woollard wrote a 22-page booklet titled: *Flow Production and Automation: Eighteen Axioms* [3]. In that booklet he said: "There are certain conditions which are necessary to the introduction of the flow-line system of production. These are axiomatic and it is essential that they be understood and appreciated by all those who contemplate the setting up a flow-line system."

Woollard quickly shifted from principles that were "virtually axiomatic" to axioms. What is the difference between a principle and an axiom? These terms are defined as follows [4]:

Principle	A basic truth, law, or assumption.
Axiom	A self-evident or universally recognized truth.

The difference between a principle and an axiom is that an axiom is self-evident while a principle may not be (hence, "virtually axiomatic"). A principle is a less rigorous term for a true statement, while an axiom is a more formal description of a true statement that requires no proof. In addition, a set of axioms must be self-consistent and not lead to conclusions that contradict one another. So why did Woollard, towards the end of his life, believe his 18 principles were in fact 18 axioms?

Woollard's extensive experience with flow production beginning in 1904 taught him that every one of the 18 axioms was necessary in order to achieve flow production. However, are these axioms really self-evident and require no proof? Readers who are familiar with flow production will recognize that each one of the 18 axioms must be in place for flow production to exist.

But would people not familiar with flow production recognize these as self-evident and requiring no proof? No, they would not. If they did, then flow would be commonplace. Batch-and-queue processing would not exist, push scheduling software systems (MRP) would never have been created, and there would have been no need to establish organizations whose sole purpose is to train people in Lean management.

The 18 principles are axioms, self-evident and not requiring any proof, only among those who have actually achieved flow; specifically, those who have built flow-lines first-hand. This constitutes a relatively small number of people because most managers ignore or cherry-pick the axioms the like the most and are thus unable to achieve flow in production (or service) activities.

Woollard's initial characterization of the 18 items as principles is the better description. He did readers a great service by providing the 18 principles and a body of related information to help them introduce flow in their businesses. Woollard's insight was certainly unique for the time, and that is still the case today.

The things that Woollard did in the 1920s to achieve flow, which in today's Lean lexicon are called standardized work, Just-In-Time, supermarkets, autonomation, takt/cycle time, quick change-over, etc., are the things that anyone must do for any product or service at any time in history or in the future to achieve flow. People must discover these innovations by themselves or through the pioneering work of others; there is no way around them. Flow is the common denominator that drives everyone to the same principles and practices. The point of convergence is singular.

Frank Woollard's eighteenth principle of flow production is worth emphasizing because it relates to the great difficulty that most organizations have in establishing the Lean management system. Woollard said (principle 18):

> "The system of production must benefit everyone – consumers, workers, and owners."

Woollard recognized that in order for flow to exist, the interests of key stakeholders – and today we would also include suppliers and communities – must not be marginalized (i.e. win-lose). In other words, flow can function only when practiced in a non-zero-sum manner (i.e. win-win). That makes abundant sense. For example, employees who lose their jobs as a result of productivity improvements (win for the company, lose for the employee) will have been harmed by flow and those who survive will refuse, in covert and overt ways, to establish, maintain, and improve the system. Flow must cause no harm.

Flow, which is the most productive and satisfying working condition, cannot exist when senior managers are committed to a zero-sum mindset. Unfortunately, most executives cannot envision anything other than zero-sum outcomes. This intellectual handicap – one of many when it comes to understanding Lean management – causes enterprise-wide queuing which, of course, makes flow impossible.

Notes

[1] F.G. Woollard, *Principles of Mass and Flow Production*, Iliffe & Sons, Ltd., London, U.K., 1954. Woollard's book was published for distribution in the United States one year later by Philosophical Library, New York, NY. The exact reference is: F.G. Woollard, *Principles of Mass and Flow Production*, Philosophical Library Inc., New York, NY, 1955

[2] F.G. Woollard with B. Emiliani, *Principles of Mass and Flow Production*, 55th Anniversary Special Reprint Edition, The CLBM, LLC, Wethersfield, Conn., 2009

[3] F.G. Woollard, *Flow Production and Automation: Eighteen Axioms*, Industrial Administration Group, College of Technology Birmingham (now Aston Business School, Aston University, Birmingham), U.K., 1954, with Foreword by Professor David Bramley, Department of Industrial Administration, College of Technology (22 pp)

[4] *The American Heritage College Dictionary*, Third Edition, Houghton, New York, NY, 1998, p. 97 and 1088

[5] See B. Emiliani, *REAL LEAN: The Keys to Sustaining Lean Management* (Volume Three), The CLBM, LLC, Wethersfield, Conn., 2008

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