Stock-Flow Fundamentals, DT and Feedback Loop - From Dynamics to System Dynamics.

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What way is most basic and indispensable for beginners to learn system dynamics ? I have posed this question when given a chance to teach the subject last year to undergraduate students who have almost no mathematical background. This paper tries to give some answers to it, though I am a beginner myself in this field.

(1) Stock-flow is fundamental to dynamic analysis

System dynamics is literally a dynamics of system and the analysis of dynamics is, in this sense, more fundamental than that of system. Hence, learning dynamics has to come first. The nature of dynamics can be easily understood in terms of stock and flow relation.

(a) Characteristics of stock and its classification. First thing to understand dynamics is to comprehend the nature of different types of stocks and classify them.

(b) Analysis of flow. Stock can only be changed by the flow into it. Time-dependent flow is the most basic of its type, and its comprehensive analysis is needed to understand a basics of dynamics.

(2) DT (delta time) and differential equations

DT is an interval of flow time, and one of the most confusing concepts in system dynamics. DT constitutes an important bridge between intuitive way of understanding dynamics and differential equations. It is easily understood by using the time-dependent flow. Runge-Kutta method is appropriately introduced at this stage.

(3) Feedback loop as a stock-dependent flow

When flow becomes dependent on its stock, a self-dynamic movement begin to evolve into system dynamics. This self-dynamics can be understood by introducing the concept of feedback loop.

With the understanding of (1), (2) and (3), beginners will be ready to move to the next step of learning system dynamics more efficiently. The next step includes a dynamics of overshoot and collapses, oscillations, chaos, etc., which involves a system of differential equations; a true level of system dynamic framework.