Why Do Hospitals Coordinate Activities As They Do?
Or
What I Learned From My Hip Surgery

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What Brought Me to the Question

Much of my professional work deals with coordination among trading partners in business settings. Thanks to having my artificial hip overhauled, I became motivated to apply my interest in coordination to hospital settings. After all, one needs something to occupy the mind when lying in a bed and restricted at home.

The staff at the University of Michigan did a great job. Everything that needed to be done was done, and always in the right order. The appropriate sequencing included matters large and small. Transition from "pre-op" to surgery. Physical therapy sign-off prior to discharge. Patient transport to and from the ultrasound imaging lab. These and myriad other inter-dependent activities took place at appropriate times relative to each other.

My most immediate observation was that while events were correctly sequenced, the sequencing was very loose. I did a lot of waiting, and never knew precisely when activities would occur. For instance, Physical Therapy had to test my stair climbing ability prior to my discharge. The "test - discharge" sequence held, but it would have been impossible to specify the time, much less the day of the test.. Similarly, the ultrasound test was scheduled for a particular day, but predicting the precise time would have been impossible. Also, waiting for patient transport back and forth from the ultrasound lab seemed endless. In all, the sequencing was right but the synchronization was loose.

Explaining Loose Coordination

Why was the coordination so loose? Once I got past the personal discomfort of waiting, I began to take this question seriously. And the more I thought about it, the more sense it made. Consider the flow of work.

- "Touch labor" time was short for all the activities that made me wait. For instance, physicians never needed more than a few minutes to make sure I was feeling well and to check the incision. Nurses never needed more than a few minutes to change the dressing. Physical Therapy session lasted about 10 minutes.

- Because of the uncertainties inherent in patient care, caregivers experience frequent interruptions.

- Because each activity takes only a few minutes, caregivers are vulnerable to those interruptions. Look at people working in a hospital. They are continually being pulled from one activity to another.

- The "cost" for each scheduling disruption is low. After all, very few patient care activities in a hospital are truly time critical within tight limits.

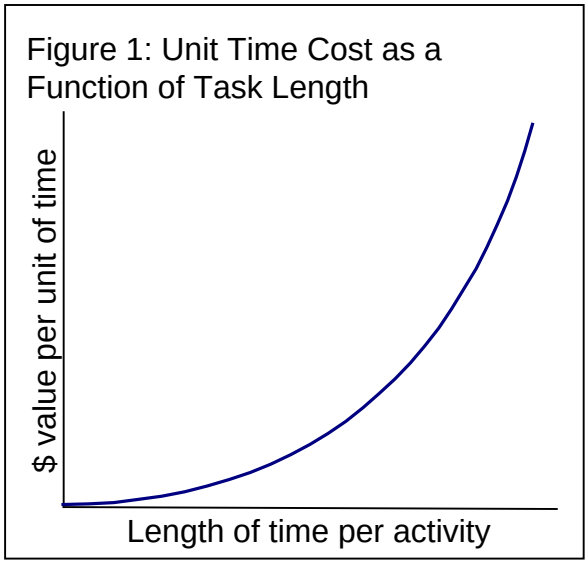
- Given the numbers of patient care activities that take place, the number of departments involved, and the number of employees within each department, the cost of tightening up the coordination would be very high. *Put another way, considerable organizational overhead would be needed to achieve tighter coordination. Improvement would require effort, time, rules and procedures, oversight systems for those rules and procedures, information systems, and networking.* All of these translate into dollars and opportunity costs.

To return to the original question: Why was the coordination so loose? Because loose coordination, while uncomfortable for the patient, provides the most rational trade-off between the quality of patient care and the cost of running a hospital.

Explaining the Coexistence of Loose and Tight Coordination

Once I understood the loose coordination I recognized a huge variance in how tightly tasks are sequenced. Some sequencing is held to exacting standards. For instance, "pre-op" was scheduled for 9:30am and surgery for 10:30 am. Both started within a few minutes of their appointed times. Why the variance? Why tight scheduling for some activities and not for others?

Following up on the theme of the cost of coordination, the answer lies in understanding how the cost structure for activities differ. I believe that two facts are relevant, as summarized in Figure 1. (The real shape of that curve, plotted against quantitative axes, would be an interesting bit of empirical research.)



- The greater the length of time for an activity, the more difficult it is to switch from one activity to another. For instance, if a task takes me 8 minutes, I can easily do it now or later and still be assured that the task will get done. But if a task takes me 8 hours, its impossible for me to perturb my schedule and still assure that the work will get done. Thus the longer a task, the more attractive the investment in the overhead needed to assure tight scheduling.

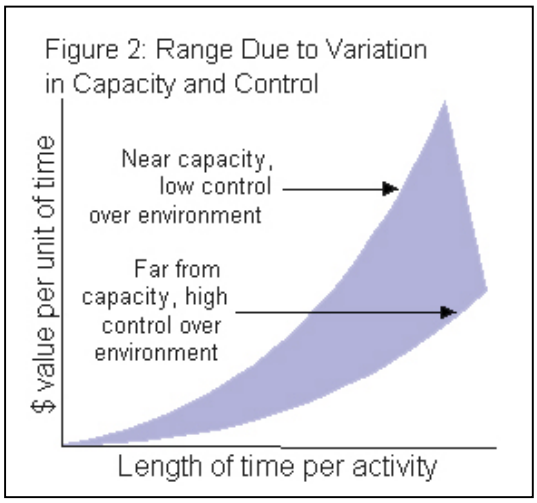
- The greater the overhead, the greater the cost per unit time.

Figure 1 explains why operating room time is carefully scheduled and ultrasound tests are not. Because surgery takes so much longer (hours instead of minutes), it is cost effective to incur the overhead of tight scheduling in one case, but not in the other.

Its tempting to explain the difference in terms of cost rather than time. After all, keeping an operating room functioning is far more resource intensive than maintaining an ultrasound scanner. I believe, however, that task time really is the operative factor. Imagine that instead of surgery, the task involved an hour of psychotherapy. Space and equipment costs are low, but schedule perturbation would still be difficult because of the time needed to complete the activity. This is not to say that cost is irrelevant. "Cost" works through "capacity", as we shall soon see.

The Complications of Capacity and Control

The simple story told in Figure 1 is complicated by two factors, as illustrated in Figure 2. (Here too the real shape of the curve awaits empirical analysis.)



- **Capacity** The closer to capacity a hospital is functioning, the greater the value of each unit of time. This is because as slack resources diminish, it becomes ever harder to accommodate change. For instance, imagine two diagnostic procedures which use different equipment, but which take the same amount of time. Test 1 resources operate at 10% capacity while test 2 resources operate at 90% capacity. Perturbed scheduling for test 1 is easily accommodated. A patient who arrives late can be asked to wait so that a patient who arrived on time can be tested. If enough patients come late the situation will become untenable, but within broad limits, most patients will get the service they need on the appointed day. Not so with test 2 where even a small number of late arrivals will assure that a high proportion of patients will not be tested. Investing overhead resources in assuring tight scheduling does not make sense for test 1, but it does for test 2.

- **Control over the environment** The greater the control, the easier it is to maintain scheduling. To see why, contrast hospitals "A" and "B", each with the same capacity to do surgery. In "A" 90% of the surgery is elective. As a result planners know with great certainty who will show up, when they will show up, and how long each procedure will take. In "B" only 50% of the surgery is elective, while the other 50% are emergencies. Planners have little knowledge about who will show up, for what reason, or how long each surgery will take. What are the overhead costs of maintaining schedules? Coordination in "A" is mostly a clerical task. Someone has to maintain the schedule, and surgeons have to clear their activities with the master scheduler. Planners in "B" have a much harder task. As patients enter through the emergency room, a triage system is needed to juggle operating room time and to match injuries with available specialists.

> Because of the need for medical judgment (perhaps based on the input of more than one expert), the cost, (i.e. the overhead investment) of coordination is high.

"Capacity limits" and "control over the environment" change the relationship between "dollars per unit of time", and "task length". The "time x length" relationship is flattest when a hospital is operating far from capacity and has high control over its environment. In this case the value of each unit of time increases only slowly with the length of an activity. The most non-linear case is where capacity limits and an uncertain environment combine to increase the overhead costs of coordination.