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Perspectives

Many readers of the MOC Best Practices newsletter already have electronic MOC systems installed or are using enterprise content management solutions to store and manage certain aspects of the MOC business process. One of the key features of electronic systems is the ability to send out reminders when an approval hasn't been completed in the expected time. Although we've all gotten these reminders, I've never seen anyone ask the rather obvious question of "how frequently should reminders be sent out?"

I've researched this problem, and some of the results are provided in this month's newsletter. The actual paper on this topic is available in the whitepapers section of our website. But, I caution you, this is a refereed journal quality document, and some readers may not have the time to wade through the math. The highlights are included in this newsletter, without the proofs, which occupy a lot of the space in the whitepaper.

So let's dive right in…

A Detailed Look at Reminders in Workflow Approvals

In a previous newsletter [1] , a lifecycle model was presented for MOC. Different lifecycles were shown depending on the duration (permanent vs. temporary), details (full detail vs. short), and urgency (emergency vs. normal). For the purposes of this discussion, the full, permanent, normal MOC is adequate and this lifecycle is depicted in the following Figure.

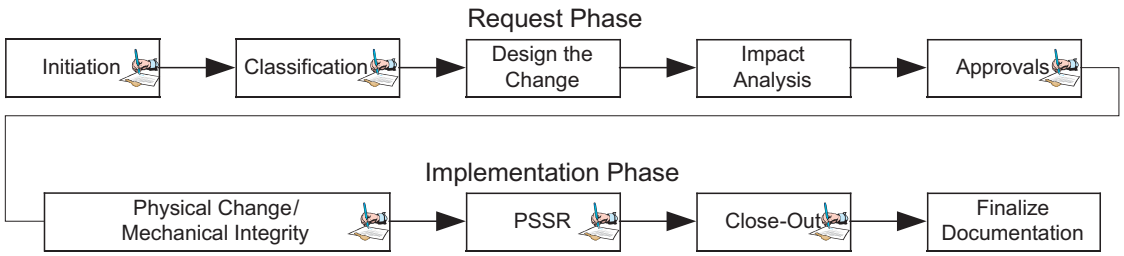

Figure 1. Full, permanent, normal MOC lifecycle, showing an Approval state plus supplementary approvals.

The presence of an "Approvals" state may mislead someone to believe that approvals/signatures/sign-offs only occur during this state. That is incorrect—signatures/sign-offs may occur at any point, as indicated by the icons in the diagram. The Approvals state is highlighted, since this is the approval to "go build", or actually implement the change. Prior approvals dealt with aspects of assessing feasibility. Subsequent approvals validate that the change was performed correctly. Also the Approvals state typically involves multiple approvals, in order to cover the technical specialties demanded by the nature of the specific MOC.

[1] Hoff, R., MOC Lifecycles, MOC Best Practices Newsletter, Vol. 1, No. 2, December 2007, Gateway Consulting Group, East Amherst, NY.

A Detailed Look at Reminders in Workflow Approvals...continued

In an electronic MOC system, approvals (whether during the Approvals state, or otherwise) are normally requested by an email notification. The approver is supposed to accept or reject the item within some timeframe, often a few days. The approver's activity, or more correctly, the approver's lack of activity is monitored by the eMOC system. Once the approval timeframe is exceeded, without an approval, the eMOC system issues a reminder to nudge the approver into completing the task.

The use of reminders is common in electronic systems, including purpose-built eMOC applications, as well as enterpirse content management systems upon which eMOC applications are often built.

There are several questions to ask about reminders: do they actually work? How well? Under what circumstances? We'll examine these questions in this newsletter. We'll use a case study approach, since it's easier to read. A comparable discussion, based on rigorous mathematical analysis, is available in a companion paper on Gateway's website.

Case Study, Part 1

Suppose an eMOC system tracks approvals. For each approval, the system:

- assigns a unique identifier
- captures the name of the approver
- captures the timestamp when the approval is requested
- captures the timestamp when the approval is granted

The difference between the "requested" and "granted" timestamps is termed the approval duration. Suppose we consider a sample of 100 approvals, of which the first few are shown in Table 1. Note that, in calculating the duration, each day is deemed to have 8 working hours.

MOC Number	Approval Requested	Approval Granted	Duration [hr]
MOC-09-1001	1/1/2009 10:41	1/3/2009 8:24	13.70
MOC-09-1002	1/1/2009 13:27	1/5/2009 8:20	26.88
MOC-09-1003	1/1/2009 15:42	1/7/2009 9:14	41.54
MOC-09-1004	1/2/2009 9:51	1/6/2009 10:00	32.15
MOC-09-1005	1/2/2009 11:10	1/5/2009 12:04	24.89
MOC-09-1006	1/2/2009 11:13	1/4/2009 12:13	16.99
MOC-09-1007	1/2/2009 12:28	1/4/2009 11:13	14.76
MOC-09-1008	1/2/2009 12:47	1/6/2009 11:04	30.29
MOC-09-1009	1/2/2009 13:32	1/4/2009 15:05	17.54
MOC-09-1010	1/2/2009 13:52	1/5/2009 11:48	21.93
. . .	. . .	. . .	. . .
MOC-09-1100	1/20/2009 15:53	1/23/2009 14:03	22.17

Table 1. Time for a single approval, without intervention.

A useful perspective can be gleaned if the dataset is sorted. The first four columns of Table 2 represent the same data as in Table 1, except that the data is sorted by duration.

If we are going to look at the impact of reminders, we'll need to represent the data in Table 2 using appropriate statistics. From a practical perspective, that's where things get difficult, since:

[2] Hoff, R., Quantifying the Effectiveness of Interventions in Workflows, submitted for publication in ASME Journal of Computing & Information Science, Dec. 15, 2008.

Case Study, Part 1...continued

- this leads to debates about which probability distribution is appropriate for the data,
- even when there is agreement on which distribution is appropriate, there's still the problem of fitting a set of data to the distribution; except for the normal distribution, this can be time-consuming and/or complex.

I've come up with a very simple approach, that, it turns out, tends to be very accurate as well. Here's how it works:

Let's define the following variables:

T_{50} 50% of the durations are less than this value. This value is easily determined from a sorted list of durations. In Table 2, T_{50} = 20.75 hr.

T_{90} 90% of the durations are less than this value. This value is easily determined from a sorted list of durations. In Table 2, T_{90} = 36.99 hr.

$\bar{t}_0$ The average approval duration, without reminders. This is a quantity that we want to minimize by sending out electronic reminders. For the data in Table 1, the average, $\bar{t}_0$ = 21.65 hr.

Case Study, Part 2

Now let's send out a reminder every 8 hours. Here are the rules:

1. If a person hasn't performed his approval after 8 hours, an electronic reminder is sent out.
2. Once a person receives the reminder, he has 8 hours to respond, otherwise another reminder is sent out. This continues, every 8 hours, until the person responds.

Assuming that these reminders are actually effective, the approval time for certain approvals (i.e. some of the late ones) will be reduced. The reduced average approval time is represented by:

$\bar{t}_\alpha$ The average approval duration, with reminders. In Table 2, the approval durations with reminders are given in the right-hand column. The average of these durations is $\bar{t}_\alpha$ = 15.43 hr.

which allows us to define an efficiency parameter:

γ The net intervention efficiency, defined by $\gamma = 1-(\bar{t}_\alpha/\bar{t}_0)$. If the reminders are totally effective, then $\gamma = 1$. If the reminders are completely ineffective, then $\gamma = 0$. However, in this case, γ = 1- (15.43/21.65) = 0.29

The net intervention efficiency is 0.29, which means that the average time for an approval to take place is 29% less with electronic reminders, than without.

Key Variables

There are 3 key variables used in the previous analysis. They are worth reviewing, since they will help with predictions in other cases.

α The effectiveness of an individual reminder. Recall that if a person didn't perform the approval within 8 hours, then another reminder was sent out, and they kept being sent out until the person responded. That means (proves!) that an individual reminder is only effective sometimes. The proportion of time that an individual reminder is effective is denoted by the symbol α, called the "individual intervention effectiveness". In the example, detailed in the right-hand column of Table 2, α = 0.5.

Δt The intervention interval. Recall that the reminders were sent out every 8 hours. They could just as easily have been sent out every 4 hours, or every 16. The intervention interval is denoted by the symbol Δt. In this example, Δt = 8hr.

T_{90}/T_{50} The skewness ratio. The greater the value of T_{90}/T_{50}, the more "stretched out" the distribution in Figure 2 appears. A more "peaked" distribution would have a smaller T_{90}/T_{50} ratio.

MOC Number	Approval Requested	Approval Granted	Duration [hr]	*Duration w/Reminders [hr]*
MOC-09-1086	1/18/2009 9:02	1/18/2009 13:46	4.74	*4.74*
MOC-09-1057	1/11/2009 15:40	1/12/2009 12:28	4.81	*4.81*
MOC-09-1056	1/11/2009 14:52	1/12/2009 12:15	5.40	*5.40*
MOC-09-1089	1/18/2009 10:46	1/19/2009 8:32	5.77	*5.77*
MOC-09-1068	1/13/2009 14:19	1/14/2009 13:18	6.98	*6.98*
MOC-09-1028	1/6/2009 12:03	1/7/2009 12:21	8.30	*8.30*
MOC-09-1074	1/15/2009 8:05	1/16/2009 8:40	8.58	*8.58*
MOC-09-1038	1/8/2009 10:17	1/9/2009 10:52	8.59	*8.59*
MOC-09-1011	1/3/2009 8:38	1/4/2009 9:18	8.67	*8.67*
MOC-09-1042	1/9/2009 8:44	1/10/2009 9:42	8.97	*8.97*
. . .	. . .	. . .	. . .	. . .
MOC-09-1044	1/9/2009 11:02	1/11/2009 13:33	18.51	*18.51*
MOC-09-1080	1/16/2009 11:10	1/18/2009 13:46	18.59	*12.65*
MOC-09-1017	1/4/2009 10:54	1/6/2009 13:58	19.06	*15.33*
MOC-09-1073	1/14/2009 13:46	1/17/2009 10:04	20.30	*20.30*
MOC-09-1048	1/10/2009 8:21	1/12/2009 12:56	20.57	*13.79*
MOC-09-1095	1/19/2009 12:32	1/22/2009 9:17	20.75	*20.75*
MOC-09-1058	1/12/2009 8:43	1/14/2009 13:32	20.82	*15.70*
MOC-09-1054	1/11/2009 13:05	1/14/2009 9:59	20.91	*13.57*
MOC-09-1077	1/15/2009 13:44	1/18/2009 10:40	20.94	*20.94*
MOC-09-1051	1/10/2009 15:09	1/13/2009 12:11	21.04	*21.04*
. . .	. . .	. . .	. . .	. . .
MOC-09-1061	1/12/2009 14:25	1/16/2009 15:36	33.17	*13.09*
MOC-09-1066	1/13/2009 11:24	1/17/2009 12:43	33.32	*28.54*
MOC-09-1071	1/14/2009 10:29	1/18/2009 14:14	35.74	*23.14*
MOC-09-1062	1/12/2009 15:11	1/17/2009 11:19	36.13	*18.76*
MOC-09-1085	1/17/2009 15:27	1/22/2009 12:26	36.99	*28.21*
MOC-09-1075	1/15/2009 10:24	1/20/2009 8:38	38.23	*15.75*
MOC-09-1026	1/5/2009 15:48	1/10/2009 15:30	39.70	*11.53*
MOC-09-1084	1/17/2009 13:55	1/22/2009 13:40	39.75	*39.75*
MOC-09-1003	1/1/2009 15:42	1/7/2009 9:14	41.54	*10.79*
MOC-09-1045	1/9/2009 12:18	1/15/2009 8:12	43.90	*12.43*
MOC-09-1021	1/5/2009 10:03	1/11/2009 8:57	46.90	*26.81*
MOC-09-1076	1/15/2009 13:21	1/21/2009 12:33	47.21	*13.04*
MOC-09-1015	1/4/2009 9:00	1/12/2009 10:37	65.62	*12.14*

Table 2.
Time for a single approval, sorted by duration, and a comparison between approvals without and with intervention.

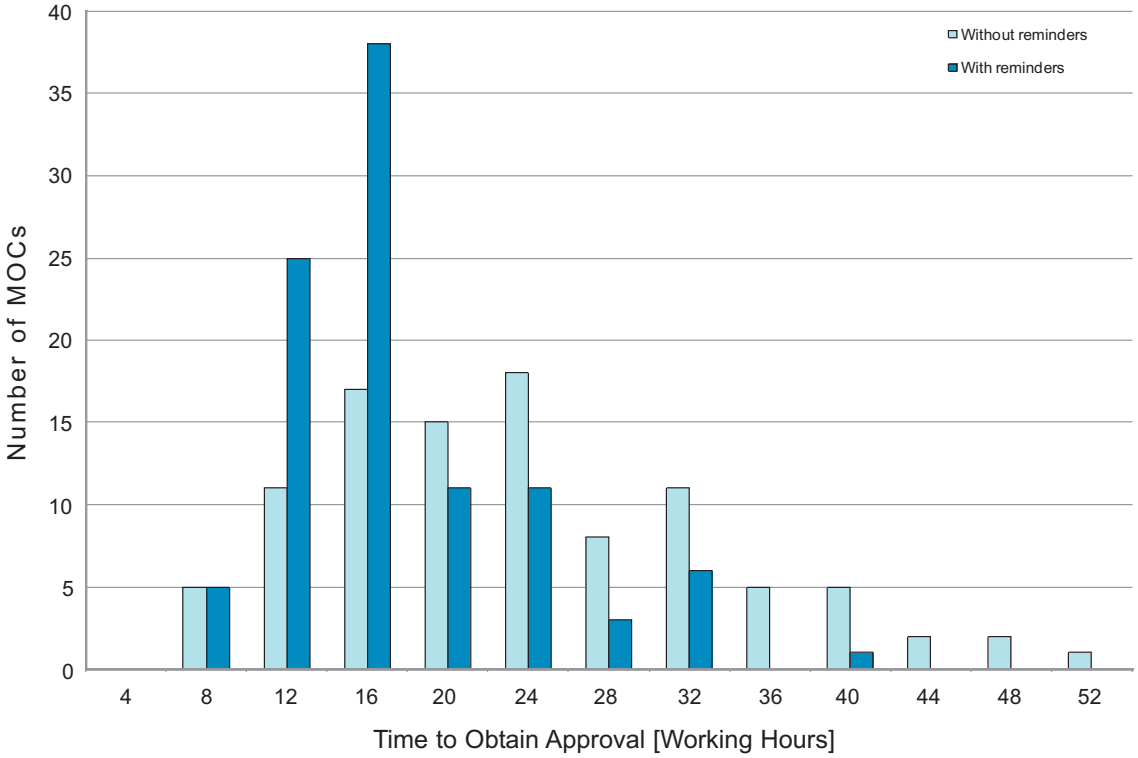

Figure 2. Time to obtain approvals with and without reminders.

Application

Based on your current MOC approval history, if you compiled data similar to Table 2 then the values of T_{50} and T_{90} would immediately become apparent. The parameters you have control over are α and Δt. α, the individual intervention effectiveness, can be increased through education and communication—encouraging people to respond to approval requests. Δt, the interval between sending out reminders, is generally set in the eMOC workflow, and is generally under your control. I would strongly discourage sending out reminders any more often than once a day, in order to avoid user resistance.

So, given values for T_{90}/T_{50}, α and Δt, the beneficial effect of reminders can be determined using the data in Table 3. Let's try it. Consider the following:

- The current eMOC system, tracks when approvals are accomplished, and this data is available for analysis.
- The wait times are calculated, being the difference between the approval timestamp and the approval request timestamp. Only 8 working hours per calendar day are taken into account.
- The median approval duration, T_{50} = 20 hr.
- The time when 90% of the approvals are complete is T_{90} = 36 hr. So, T_{90}/T_{50} = 1.8.
- The average wait time $\bar{t}_0$=21.2 hr. Note that the median time and the mean time are generally not equal.

Your organization wishes to accelerate the approvals, by instituting a daily reminder for tardy approvals. How much will the approvals be accelerated, if approvers are likely to respond to about one-half of the reminders? That is:

- $\Delta t/T_{50}$ = 8/20 = 0.4
- α = 0.5

From Table 3, γ = 0.2994
From the definition of γ, $\bar{t}_\alpha=\bar{t}_0(1-\gamma)$= 21.2(1-.2994)= 14.85 hr
That is, using the parameters as described in the problem description, the average wait time will be reduced from 20 hr to 14.85 hr.

T_{90}/T_{50} = 1.8	Tabulated values are net intervention efficiency, γ									
					$\Delta t/T_{50}$					
α	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
0%	-	-	-	-	-	-	-	-	-	-
10%	0.3861	0.2012	0.1200	0.0757	0.0492	0.0316	0.0201	0.0128	0.0076	0.0046
20%	0.5693	0.3420	0.2179	0.1425	0.0940	0.0617	0.0399	0.0251	0.0152	0.0091
30%	0.6694	0.4430	0.2977	0.2015	0.1359	0.0903	0.0588	0.0371	0.0228	0.0131
40%	0.7305	0.5175	0.3635	0.2535	0.1744	0.1175	0.0772	0.0491	0.0301	0.0177
50%	0.7708	0.5741	0.4183	0.2994	0.2101	0.1437	0.0957	0.0611	0.0373	0.0220
60%	0.7992	0.6175	0.4642	0.3402	0.2428	0.1681	0.1130	0.0725	0.0449	0.0266
70%	0.8201	0.6517	0.5027	0.3765	0.2735	0.1918	0.1298	0.0841	0.0520	0.0307
80%	0.8361	0.6792	0.5354	0.4087	0.3014	0.2142	0.1462	0.0952	0.0595	0.0349
90%	0.8487	0.7016	0.5632	0.4374	0.3274	0.2354	0.1621	0.1062	0.0664	0.0391
100%	0.8589	0.7203	0.5872	0.4630	0.3515	0.2555	0.1774	0.1172	0.0733	0.0434

T_{90}/T_{50} = 3.0	Tabulated values are net intervention efficiency, γ									
					$\Delta t/T_{50}$					
α	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
0%	-	-	-	-	-	-	-	-	-	-
10%	0.5306	0.3404	0.2393	0.1775	0.1360	0.1069	0.0855	0.0693	0.0561	0.0467
20%	0.6870	0.5004	0.3788	0.2949	0.2345	0.1886	0.1537	0.1264	0.1043	0.0865
30%	0.7608	0.5923	0.4700	0.3789	0.3084	0.2533	0.2098	0.1741	0.1459	0.1223
40%	0.8036	0.6521	0.5341	0.4409	0.3662	0.3056	0.2566	0.2156	0.1815	0.1541
50%	0.8315	0.6940	0.5815	0.4889	0.4127	0.3489	0.2959	0.2511	0.2135	0.1816
60%	0.8512	0.7247	0.6176	0.5271	0.4504	0.3849	0.3296	0.2820	0.2412	0.2067
70%	0.8657	0.7482	0.6464	0.5582	0.4817	0.4156	0.3585	0.3088	0.2663	0.2294
80%	0.8769	0.7671	0.6698	0.5839	0.5083	0.4419	0.3839	0.3328	0.2884	0.2498
90%	0.8858	0.7823	0.6890	0.6055	0.5312	0.4650	0.4063	0.3545	0.3087	0.2687
100%	0.8931	0.7947	0.7052	0.6239	0.5506	0.4849	0.4259	0.3735	0.3268	0.2855

T_{90}/T_{50} = 5.0	Tabulated values are net intervention efficiency, γ									
					$\Delta t/T_{50}$					
α	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
0%	-	-	-	-	-	-	-	-	-	-
10%	0.6823	0.5199	0.4162	0.3446	0.2905	0.2495	0.2172	0.1905	0.1686	0.1510
20%	0.7964	0.6630	0.5649	0.4892	0.4289	0.3792	0.3377	0.3025	0.2733	0.2465
30%	0.8455	0.7330	0.6445	0.5719	0.5118	0.4607	0.4168	0.3784	0.3454	0.3159
40%	0.8731	0.7749	0.6942	0.6260	0.5679	0.5171	0.4728	0.4333	0.3985	0.3675
50%	0.8909	0.8029	0.7287	0.6644	0.6085	0.5589	0.5150	0.4752	0.4400	0.4078
60%	0.9033	0.8231	0.7540	0.6931	0.6394	0.5912	0.5480	0.5088	0.4731	0.4408
70%	0.9125	0.8384	0.7734	0.7157	0.6638	0.6170	0.5744	0.5355	0.5004	0.4678
80%	0.9196	0.8503	0.7888	0.7336	0.6835	0.6381	0.5964	0.5583	0.5227	0.4906
90%	0.9252	0.8599	0.8013	0.7483	0.7000	0.6557	0.6146	0.5770	0.5424	0.5101
100%	0.9298	0.8678	0.8118	0.7606	0.7138	0.6705	0.6305	0.5934	0.5589	0.5270

Table 3.
Dependence of net intervention efficiency on intervention interval and individual intervention effectiveness, for various values of skewness ratio.

Conclusions

In this letter we've characterized the effectiveness of reminders in eMOC systems. The complexity of trying to fit approval durations to a statistical distribution has be removed by redefining the durations in terms of two, easy to establish, parameters: T_{50} and T_{90}. Furthermore, the ability to predict the improvement (decrease) in approval times is reduced to a simple equation, with the necessary parameters provided in Table 3.