International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 03, 2019
ISSN: 1475-7192

Spin Retry Count Relation with Other Hdd Parameters

Iskandar Nailovich Nasyrov[1], Ildar Iskandarovich Nasyrov[1], Rustam Iskandarovich Nasyrov[1] and Bulat Askarovich Khairullin[1]

Abstract--- *The change of the SMART parameter 10 Spin retry count values depending on the operating time is considered; this parameter characterizes the number of repeated attempts to spin the disks up to operating speed if the first attempt was unsuccessful. This parameter is critical in the sense that if the value of the attribute increases, then the likelihood of malfunctions in the mechanical part of the hard disk drives is high. The scientific task of the study is to establish the relationship between this parameter in failed hard drives and the values of other reliability parameters for information stores from various manufacturers.In the course of the study, the drives of the HGST, Hitachi, Samsung, ST, Toshiba, WDC trademarks operated in the Backblaze largest commercial data centre were analysed.As a result of the analysis, the relationship between the specified parameter andsuch parameters as 3 Spin-up time (time of spinning the disk package from standstill to operating speed), 4 Start / stop count (counting the spindle start / stop cycles), 12 Power cycle count (number of fulldrive switching on / off cycles), 192 Power-off retract count (the number of shutdown cycles, including emergency), 193 Load cycle count (the number of magnetic head block moves in the parking zone / in working position cycles). It is shown that the nature of the change in the values of the considered parameters depends on the manufacturer of the hard drives. It is proposed to carry out an individual assessment of the information storage device rotation mechanism reliability using the parameters identified as a result of the study.*

Keywords---*Rotation Mechanism, Hard Drive, Reliability, Information, Security, Drive.*

I. INTRODUCTION

To ensure information security, it is necessary to timely and completely copy data from an unreliable drive to a new and reliable drive.For this purpose, SMART technology (self-monitoring, analysis and reporting technology [1]) is usually used for internal assessment of the state of a computer's hard drive, as well as a way of predicting its possible failure.The paper considers the change from the operating time of the parameter 10 Spin retry count which characterizes the number of repeated attempts to spin up the disks to the operating speed if the first attempt was unsuccessful. This parameter is critical in the sense that if the value of the attribute increases, then the likelihood of malfunctions with the mechanical part of the hard disk drives is high. The scientific task of the study is to establish the relationship between this parameter in failed hard drives with the values of other reliability parameters for information stores of various manufacturers.

In the course of the study, the parameters of failed drives of brands such as HGST, Hitachi, Samsung, ST, Toshiba, and WDC operated in the largest commercial data centreBackblazewere analysed. As a result of the

[1]*Kazan Federal University. E-mail: ecoseti@yandex.ru*

analysis, the relationship between the parameter 10 Spin retry count and parameters 3 Spin-up time (time to spin a disk package from standstill to operating speed), 4 Start / stop count (counting spindle start / stop cycles), 12 Power cycle count (number of full disk on / off cycles), 192 Power-off retract count (the number of shutdown cycles, including emergency cycles), 193 Load cycle count (the number of cycles for moving the block of magnetic heads to the parking zone / to the working position).

It is shown that the very existence of the values of the considered parameters and the nature of their change depending on the operating time of the information storage devices depend on the manufacturer.An individual assessment of the hard drive rotation mechanism reliability is proposed to be performed using the parameters identified as a result of the study.

II. METHODS

To analyse the dependence of the parameter values on the operating time of the failed information storage devices on hard magnetic disks, the SMART data listed on the Backblaze website [2] was studied. 45 parameters SMART 92530 were examined for 93 drive models of 6 brands HGST (Hitachi Global Storage Technologies), Hitachi (later HGST), Samsung, ST (Seagate), Toshiba, WDC (Western Digital) for the period from April 10, 2013, to December 31, 2016. It was found that at the end of the study period, 79.58% of drives continued to work normally, 14.74% were prematurely decommissioned, and 5.68% failed.

In total, information about the semantic value of more than 80 SMART parameters is available, but most of them are not used by manufacturers. Therefore, Backblaze specialists recorded only 40 of them in 2013-2014, and since 2015, there were recorded 45 with numbers 1-5, 7-13, 15, 22, 183, 184, 187-201, 220, 222-226, 240 -242, 250-252, 254, 255 (in 2015, 22, 220, 222, 224, 226 were added).

Among these parameters, three groups can be distinguished: which values are being accumulated (of the “count” type), which values reflect the rate of change (of the “rate” type or similar in meaning), and which values are associated with other parameters (also of the “count” type or similar). According to another classification, three groups of parameters can also be identified: those related to the state of the memory space — the surface of the disks, the positioning of the write/read heads, and the hard drive mechanics.

Storage defects can also be divided into two large groups: physical and logical. Physical defects include surface defects, servo errors, and bad hardware sectors. The latter arise due to malfunctioning mechanics or electronics drives. Such problems include breakage of the heads, displacement of the disks or a bent shaft as a result of an impact, dusting off the hermetic zone, as well as various interruptions in the operation of electronics. Errors of this type are usually catastrophic and cannot be corrected programmatically.

Logical defects arise not because of surface damage, but because of violations of the logic of the sector.They can be divided into correctable and uncorrectable.Logical defects have the same external manifestations as physical ones, and they can be distinguished only indirectly according to the results of various tests.

Thus, the essence of the research method is to compare the changes in the value of the SMART parameters of the failed information storage devices and to identify time coincidences in them.

III. RESULTS AND DISCUSSION

When analysing the 10 Spin-up retry count parameter which characterises the state of the rotation mechanism, it was detected that a failed hard drive of the HGST trademark has a coincidence in time of changes with the parameters 3, 4, 12, 192, 193 (Figure 1).Moreover, an increase in the value of parameter 10 coincides with a decrease in the value of parameter 3, although this behaviour is not always observed. Nevertheless, taking into account this circumstance when selecting for relative [3] or absolute [4] values, will allow us not to lose sight of the necessary parameters.In other words, the requirement of a monotonic change in the values in the series of“normal”, “taken ahead of schedule”, “failed” ones, can be replaced by a simultaneous increase (decrease) in the values “taken ahead of schedule” and “failed” drives compared to normal devices.

A similar coincidence was observed for other failed drives of the HGST brand (Figure 2) (total of 3 pieces), Hitachi (Figures 3, 4) (total of 5 pieces), Toshiba (Figure 5) (1 piece), for which parameter 10 had nonzero values. For disks of other manufacturers that lost working capacity, it was equal to zero or completely absent.

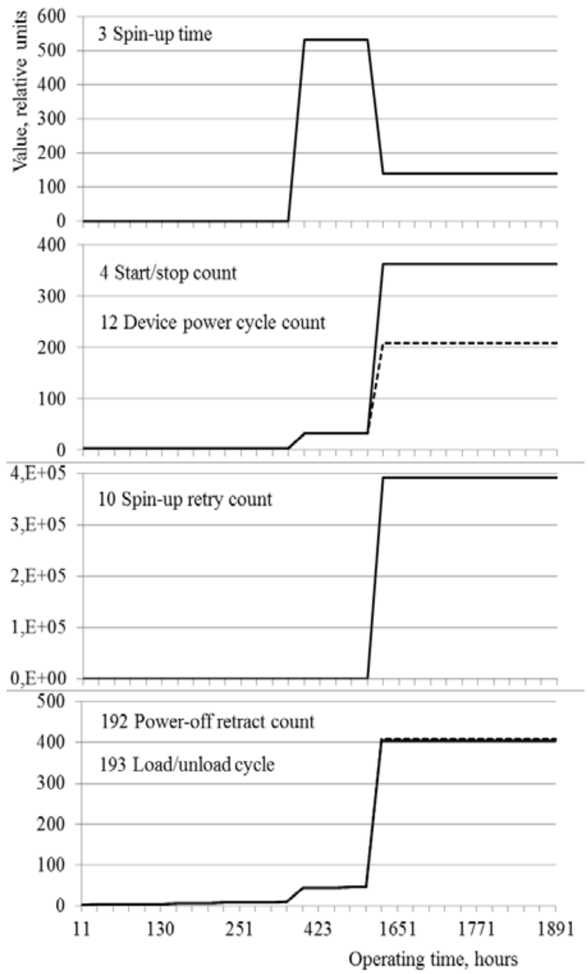

Figure 1: Parameter values 3, 4, 10, 192 (solid lines), 12, 193 (dotted lines) vs. the operating time for a failed hard drive model HGST HMS5C4040BLE640 with number PL2331LAGGW6UJ and with a capacity of 4 TB

Received: 10 Mar 2019 | Revised: 27 Mar 2019 | Accepted: 25 Apr 2019

International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 03, 2019
ISSN: 1475-7192

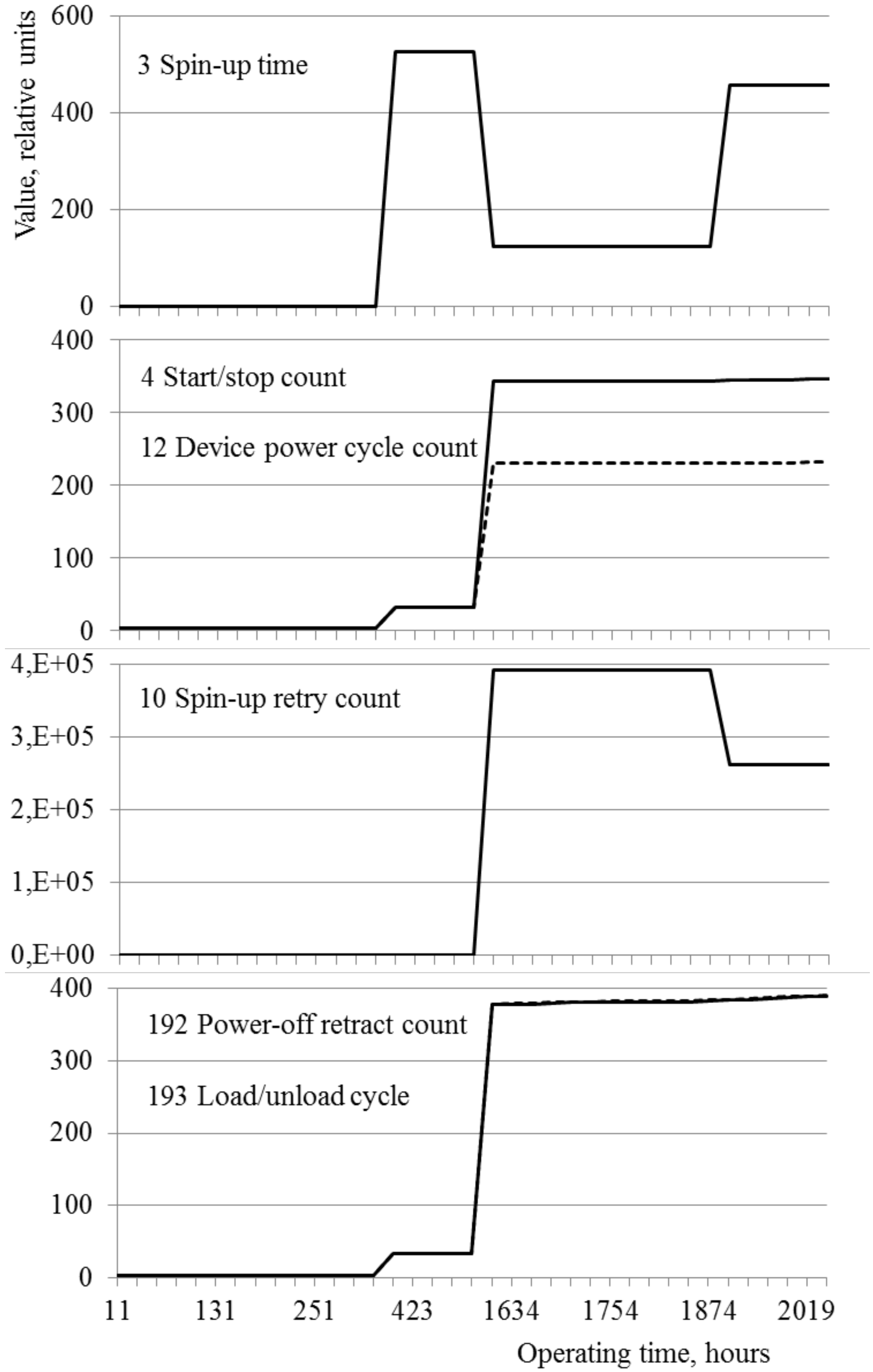

Figure 2: Parameter values 3, 4, 10, 192 (solid lines), 12, 193 (dotted lines) vs the operating time for a failed hard drive model HGST HMS5C4040BLE640 with number PL1331LAGLXLEH and with a capacity of 4 TB

Received: 10 Mar 2019 | Revised: 27 Mar 2019 | Accepted: 25 Apr 2019

International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 03, 2019
ISSN: 1475-7192

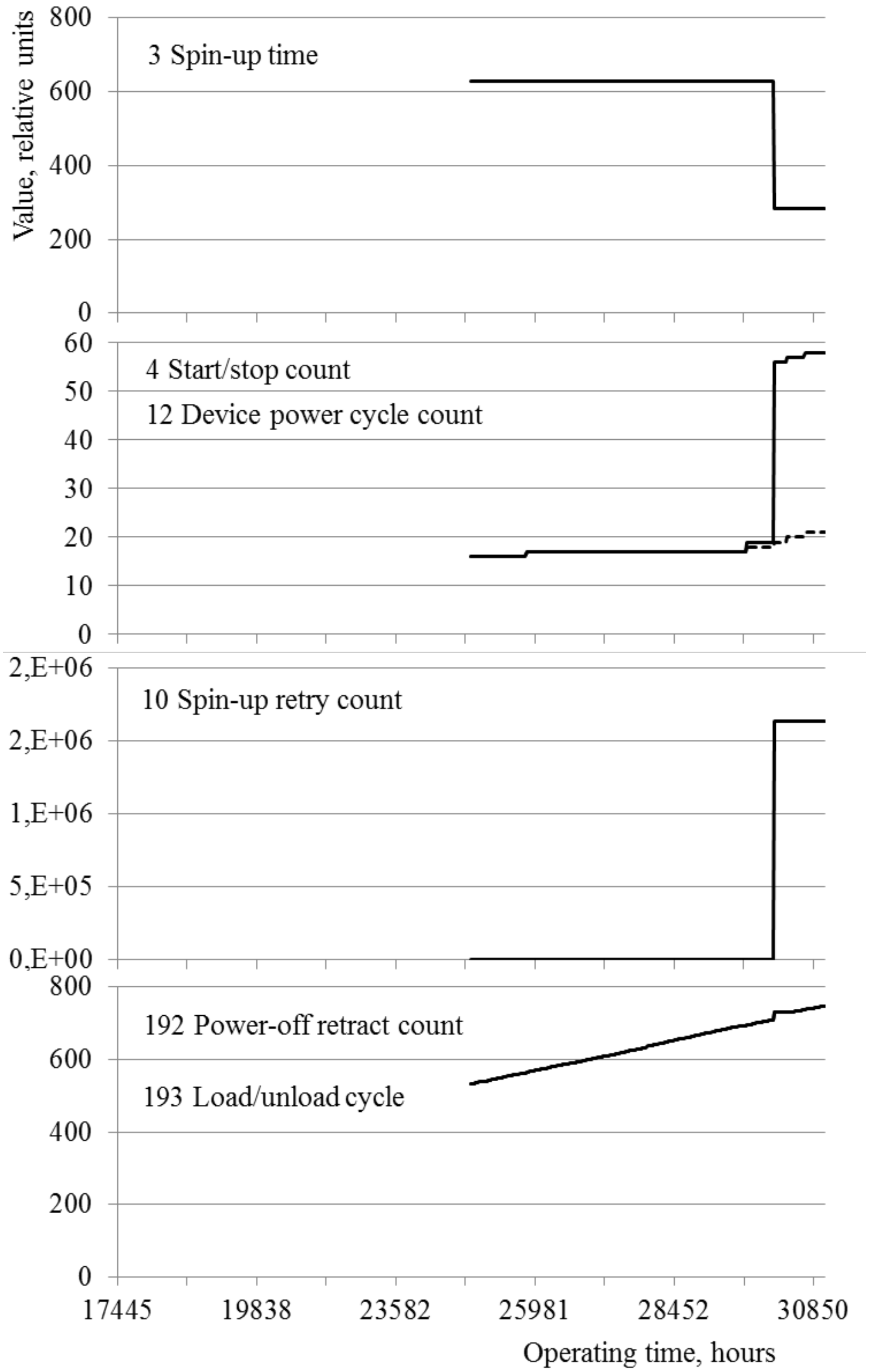

Figure 3: Parameter values 3, 4, 10, 192 (solid lines), 12, 193 (dotted lines) vs. the operating time for the failed Hitachi HDS722020ALA330 model hard drive with a 2 TB and number JK11A4B8J22ZNW

Received: 10 Mar 2019 | Revised: 27 Mar 2019 | Accepted: 25 Apr 2019

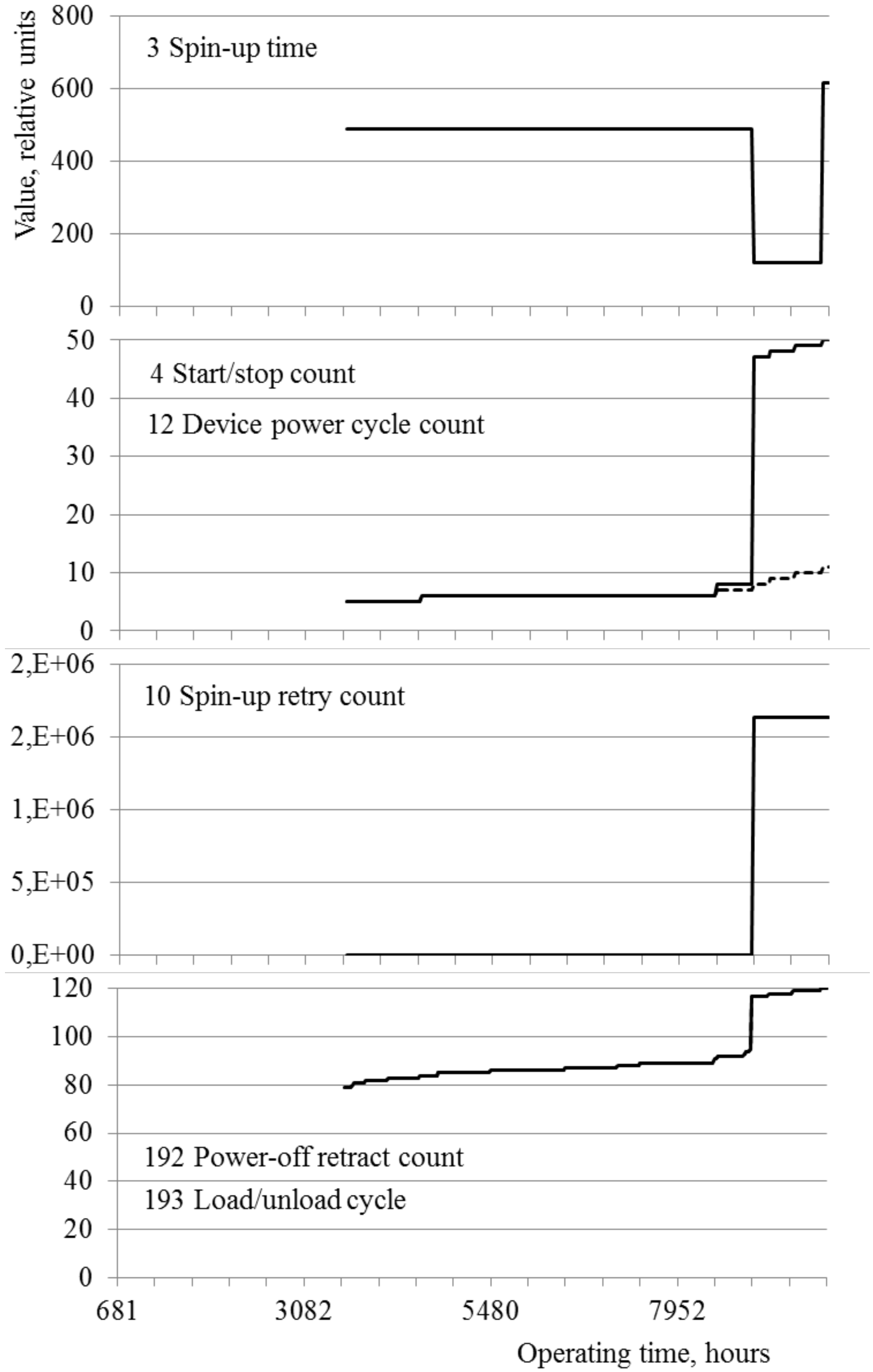

Figure 4: Parameter values 3, 4, 10, 192 (solid lines), 12, 193 (dotted lines) vs. the operating time for the failed Hitachi HDS722020ALA330 model hard drive with a 2 TB and number JK11A5B8KK8Z2X

International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 03, 2019
ISSN: 1475-7192

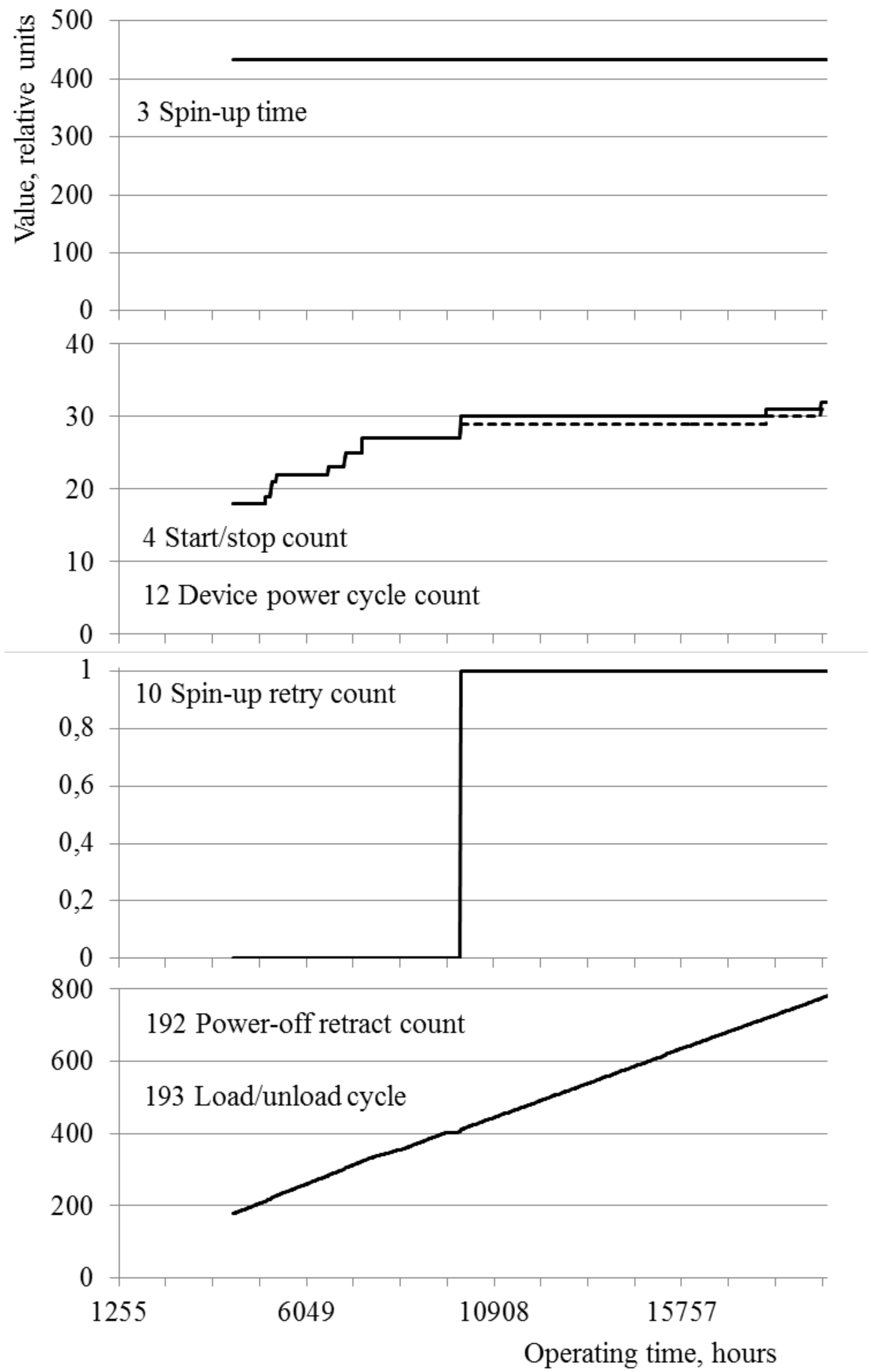

Figure 5: Parameter values 3, 4, 10, 192 (solid lines), 12, 193 (dotted lines) vs. the operating time for the failed Toshiba DT01ACA300 model hard drive with the number 13H883WAS and a capacity of 3 TB

Here, the parameter 3 Spin-up time characterizes the time of spin-up of a disk pack from the idle state to the operating speed. Its value increases due to wear and tear of mechanics, increased friction in the bearing, and may also indicate poor power supply (for example, a voltage drop at the start of the disk).Parameter 4 Start/stop count characterizes the total number of starts/stops of the disk. Parameter 10 Spin retry count characterizes the total number of attempts starting rotation in order to achieve full working speed (provided that the first attempt failed).An increase in the value of this attribute is a sign of problems in the mechanical subsystem of the hard drive. Parameter 12 Power cycle count shows the number of complete power on/off cycles of the hard drive. Parameter 192 Power-off retract count shows the number of shutdown cycles or emergency failures (drive power on / off). Parameter 193 Load cycle count shows the number of magnetic head block movement cycles in the parking zone / in the working position.

As can be seen from Figures 1-5, parameters 4, 12, 192, 193 are cumulative; their values only increase with increasing operating time.But they are not very convenient to assess the mechanical reliability of drives, because they depend not only on the state of the disk drives. Instead, the parameters 3 and 10 which turned out to be interconnected could well be used to assess reliability. Moreover, it is precisely the changes in values, and mainly its absolute values, that are important in parameter 3, and in parameter 10, respectively.In addition, 74 HGST drives have non-zero values of parameter 3 (out of a total of 167 failed); this correlation is 409 out of 510 for Hitachi, 1 out of 1 for Samsung, 16 out of 4156 for ST, 10 out of 12 for Toshiba, and 290 out of 404 for WDC.

The number of failed drives depending on the operating time has two types: falling and dome-shaped [5]. The first type means that disk failures occur immediately after the start of their use, which is the so-called "infant mortality". The second type is associated with wear and tear and occurs mainly after the expiration of the two-year warranty period. As can be seen from the above figures, failures associated with the mechanics of disk drives can be of both types.

IV. SUMMARY

As a result, according to the results of the study, it was found that six SMART parameters have coincident changes in parameter values for failed hard drives. These are parameters with numbers 3, 4, 10, 12, 192, 193. However, some of them, namely parameters 4, 12, 192, 193, characterise the total number of starts/stops of the disk with slight semantic nuances.Of course, their sharp increase may be due, inter alia, to problems in the mechanical subsystem, but only parameters 3 and 10 are intended and really directly speak about errors in the mechanical part of hard drives.

The scientific novelty of the obtained results lies in the fact that on the basis of the identified parameters characterizing the mechanical subsystem of the hard drives, it is possible to develop criteria for the danger of drive failures.They are justified due to the existence of the fact that, as a result of the analysis, the coincidence in time of changes in the values of these parameters exists.

V. CONCLUSIONS

Similar studies on the same data with heterogeneous disk groups were carried out in [6], where a search was made for universal predictors of disk failures that could be applied to disks of all makes and models.The main problem was a significant number of SMART parameters, data for which were not available for most brands and models of disks.As a result, the authors were forced to discard parameters that were absent in at least 90% of the disks, after which only 21 parameters remained.

In [7–11], the SMART parameters of the specified data set of the Backblaze data centre were also used to determine the intensity and predict failures of disk information storage devices.

Therefore, the issue of assessing the reliability of information storage devices by the values of SMART parameters is really important for ensuring data security in any organization. Based on the detected coincidence in time of the change in the parameter values of failed hard drives, it is proposed to solve the problem of individual assessing the reliability of information storage devices in relation to the mechanical part using the identified parameters.

ACKNOWLEDGEMENTS

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

REFERENCES

[1] S.M.A.R.T. From Wikipedia, the free encyclopedia. URL: https://en.wikipedia.org/wiki/S.M.A.R.T. Checked 24.03.2019.

[2] Hard Drive Data and Stats / Backblaze. URL: https://www.backblaze.com/b2/hard-drive-test-data.html. Checked 24.03.2019.

[3] Nasyrov I.N., Nasyrov I.I., Nasyrov R.I., Khairullin B.A. Data mining for information storage reliability assessment by relative values // International Journal of Engineering and Technology (UAE). 2018. Vol.7, Is.4.7 Special Issue 7. P.204-208. URL: https://www.sciencepubco.com/index.php/ijet/article/view/20545.

[4] Nasyrov I.N., Nasyrov I.I., Nasyrov R.I., Khairullin B.A. Parameters selection for information storage reliability assessment and prediction by absolute values // Journal of Advanced Research in Dynamical and Control Systems. 2018. Vol.10, Is.2 Special Issue. P.2248-2254. URL: http://jardcs.org/backissues/abstract.php?archiveid=5363.

[5] Nasyrov I.N., Nasyrov I.I., Nasyrov R.I., Khairullin B.A. Dependence of reallocated sectors count on HDD power-on time // International Journal of Engineering and Technology (UAE). 2018. Vol.7, Is.4.7 Special Issue 7. P.200-203. URL: https://www.sciencepubco.com/index.php/ijet/article/view/20544.

[6] Rincón C.A.C., Paris J.-F., Vilalta R., Cheng A.M.K., Long D.D.E. Disk failure prediction in heterogeneous environments // Proceedings of the International Symposium on Performance Evaluation of Computer and Telecommunication Systems, SPECTS 2017. Seattle, WA, USA, July 9-12, 2017. URL: http://ieeexplore.ieee.org/document/8046776/.

[7] Qian J., Skelton S., Moore J., Jiang H. P3: Priority-based proactive prediction for soon-to-fail disks // Proceedings of the 10th IEEE International Conference on Networking, Architecture and Storage, NAS 2015. Boston, MA, USA, August 6-7, 2015. – 7255224. – p. 81-86. URL: http://ieeexplore.ieee.org/document/7255224/.

[8] Botezatu M.M., Giurgiu I., Bogojeska J., Wiesmann D. Predicting disk replacement towards reliable data centres// Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, KDD '16. San Francisco, California, USA, August 13-17, 2016. – p. 39-48. URL: https://dl.acm.org/citation.cfm?doid=2939672.2939699.

[9] Chaves I.C., de Paula M.R.P., Leite L.G.M., Queiroz L., Pordeus J.P., Machado J.C. BaNHFaP: A Bayesian Network-Based Failure Prediction Approach for Hard Disk Drives // Proceedings of the 5th Brazilian Conference on Intelligent Systems, BRACIS 2016. Recife, Pernambuco, BR, October 9-12, 2016. – 7839624. – p. 427-432. URL: http://ieeexplore.ieee.org/document/7839624/.

[10] Gaber S., Ben-Harush O., Savir A. Predicting HDD failures from compound SMART attributes // Proceedings of the 10th ACM International Systems and Storage Conference, SYSTOR '17. Haifa, Israel, May 22-24, 2017. – Article No. 31. URL: https://dl.acm.org/citation.cfm?doid=3078468.3081875.

[11] Gopalakrishnan P.K., Behdad S. Usage of product lifecycle data to detect hard disk drives failure factors // Proceedings of the ASME International Design Engineering Technical Conference. Cleveland, Ohio, USA, August 6–9, 2017. URL: http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleid=2662132.